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AEROPALYNOLOGICAL STUDIES IN THE MAKATI AREA, 1968—69

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SIX TEXT FIGURES

ABSTRACT

An aeropalynological study was conducted for 1 year in the Makati area to determine the prevalent pollen types in the atmosphere which are most likely allergenic. Gramineae was found to be the most abundant pollen type. Other pollen types found, in the order of decreasing abundance, were Moraceae, Leguminosae, Myrtaceae, Cyperaceae, Cruciferae, Casuarinaceae, Amaranthaceae, Compositae, Palmae, and Umbelliferae. Highest pollen count was obtained in November and the least in June. The period of greatest abundance of each pollen type, their most probable sources and their patterns of deposition were discussed. Results were further correlated with biotic factors such as habit, distribution, absolute pollen production and pollination calendar of plant sources and climatological factors such as rainfall, humidity, temperature, wind velocity and direction, and cloudiness.

INTRODUCTION

In the study of pollen allergy, a knowledge of the pollens prevalent in the atmosphere is necessary since most allergenic pollens are anemophilous or carried by the wind through high altitude and great distances. Atmospheric pollen counts, therefore, are made to determine the kinds and relative amount of the predominant pollen grains in the atmosphere and their seasonal occurrence. By correlating the results with a simultaneous botanical survey, we can identify the most probable allergenic plants in an area.

The distribution of anemophilous pollens, in spite of their wide range, is largely influenced by the local vegetation. Thus simulta-

neous aeropalynological surveys in different countries have yielded various results. In the United States, for instance, ragweed was found to be the most prevalent alergenic plant [Feinberg (1916)] while in Australia, grasses predominated [Moss (1965) and Derrick (1966].

In the Philippines, Payawal and Laserna (1966) made an aeropalynological study of the Manila area and found that grasses were the predominant pollen grains. Continuing these studies, we established stations in Makati and its proximity to Manila will enable us to compare results.

MATERIALS AND METHODS

Standard Durham gravity slide samplers were stalled at the roof of three of the tallest buildings in Makati: (*1*) Insular Life Building (2) Makati Municipal Building, and (*3*) Our Lady of Guadalupe Minor Seminary. Glass slides thinly coated with glycerine jelly were placed in the slide holders and exposed for 24 hours except during week-ends and holidays. This was started on September 17, 1968 and continued for 1 year, ending on September 17, 1969.

The exposed slides were collected in covered slide boxes and covered with 22 mm cover slips in the laboratory. These were then examined under a compound binocular microscope under low power magnification and occasionally under high power magnification for identification. Counting was done by making successive horizontal trips across the entire width until the area of the cover slip was covered and the results were expressed as pollen count per sq cm. Pollen grains encountered were identified by comparing them with prepared specimens mounted in the same medium and by referring to the literature.

RESULTS

The pollen types encountered, arranged in the order of decreasing abundance as presented in Table 1, were Gramineae, Moraceae, Leguminosae, Myrtaceae, Cyperaceae, Cruciferae, Casuarinaceae, Amaranthaceae, Compositae, Palmae, and Umbelliferae. There were also forms unidentified. Total pollen count was highest in November with 172 pollen grains per sq cm and least in the months of June and September with a total count of 28 pollen grains per sq cm (Table 1, Figure 1).

Gramineae, with a total annual count of 420 pollen grains per sq cm was the most abundant pollen type (Table 1. Figure 2). The

TABLE 1. — *Average pollen incidence of different pollen types per sq cm slide surface in the Makati area from September* 1968 *to September* 1969.

Pollen type	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Annual total
Gramineae	14	18	138	101	50	32	17	11	9	9	13	8	420
Moraceae	—	—	2	7	14	12	16	10	13	3	1	1	79
Leguminosae	—	1	1	3	8	10	19	9	7	3	4	2	67
Myrtaceae	—	—	—	—	8	6	12	2	8	4	1	—	41
Cyperaceae	—	1	—	—	1	—	1	1	1	2	22	—	29
Cruciferae	—	—	—	1	9	4	6	3	1	—	—	—	24
Casuarinaceae	—	—	—	—	—	—	—	—	—	—	—	22	22
Amaranthaceae	12	1	1	1	3	1	1	—	—	—	—	—	20
Compositae	—	—	8	1	1	1	—	1	1	—	—	—	13
Palmae	—	—	—	1	1	1	2	1	4	—	—	—	10
Umbelliferae	—	—	—	—	—	—	4	—	—	—	—	—	4
Unidentified	2	10	22	43	53	26	27	25	23	7	6	4	248
Monthly total	28	31	172	158	148	93	105	63	67	28	47	37	977

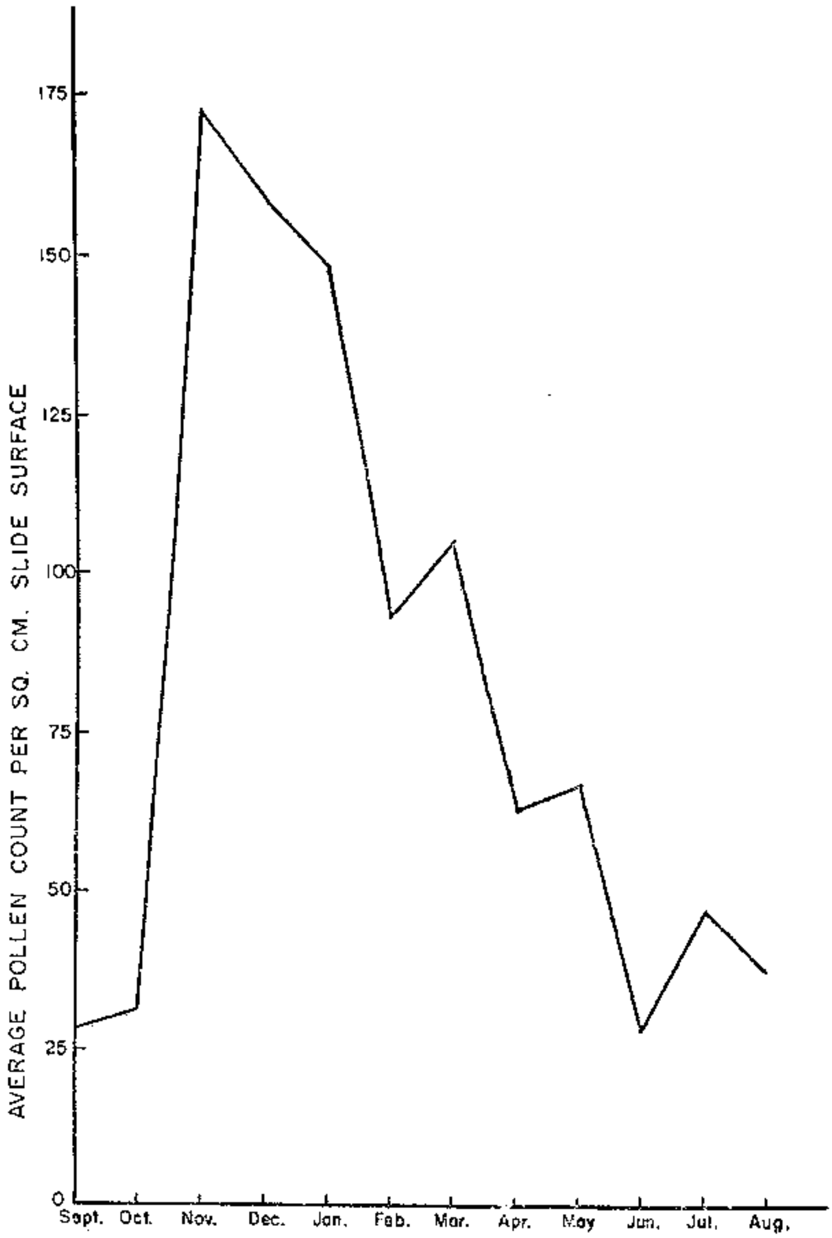

FIG. 1. Graph of the monthly average of total pollen deposition.

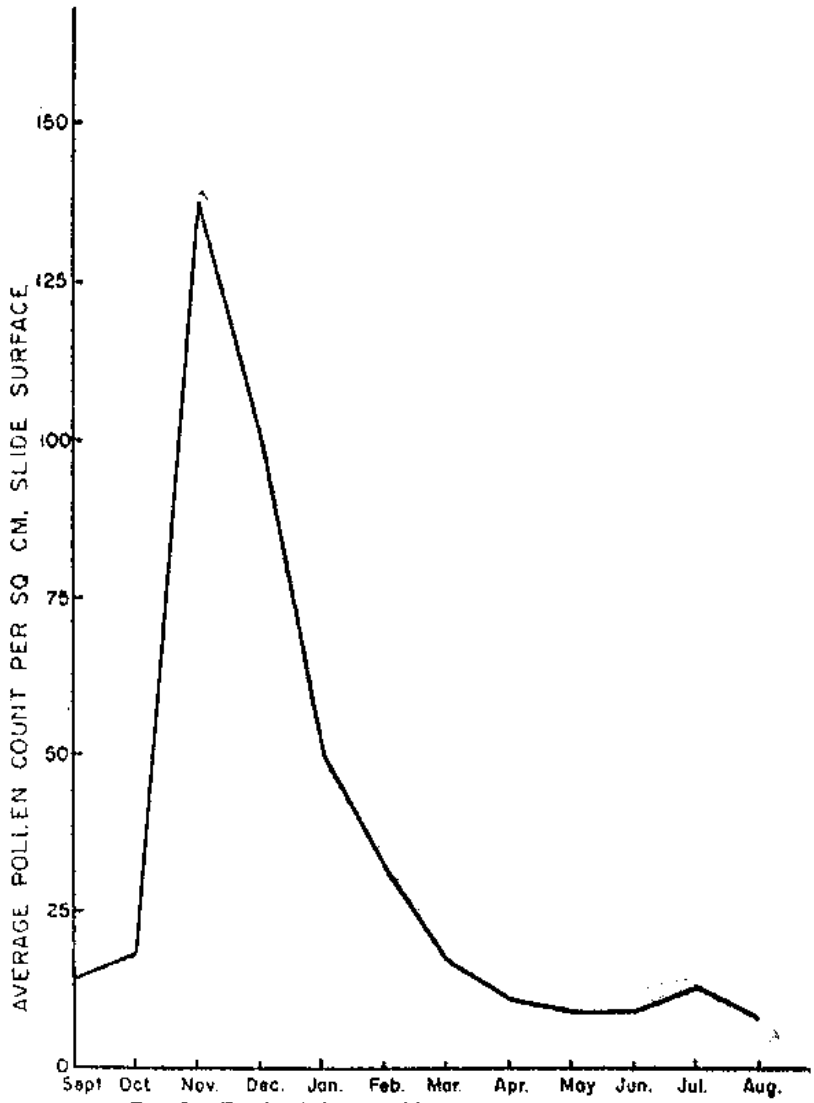

FIG. 2. Graph of the monthly average of Gramineæ pollen.

plants that may be responsible for these graminaceous pollens named in the order of their abundance are yard grass [*Eleusine indica* (L.) Gaertn.], alabang-x [*Dicanthium aristatum* (Poir.) C. E. Hubb.], foxtail [*Pennisetum polystachyon* (L) Schult.], java grass [*Polytrias amaura* (Büse) O. Ktze.], jungle grass [*Echinochloa colonum* (L.) Link.],

talahib (*Saccharum spontaneoum* Linn.), and delhi grass [*Bothriochloa ewartiana* (Don.) C. E. Hubb.] as determined from a botanical survey done by Remo and Laserna (unpublished report).

Moraceae ranked second with a total count of 79 pollen grains per sq cm and was most abundant in March as shown in Table 1 and

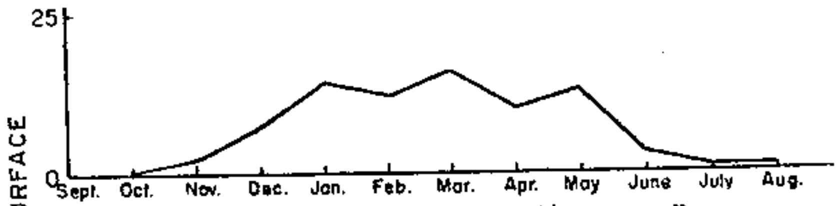

FIG. 3. Graph of the monthly average of Moraceæ pollen.

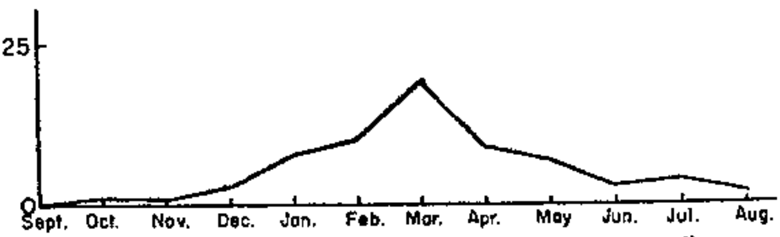

FIG FIG. 4. Graph of the monthly average of Leguminosæ pollen.

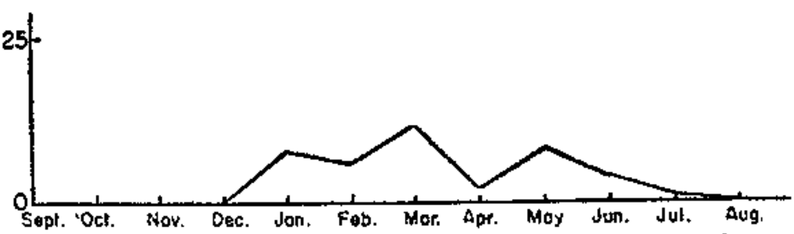

FIG. 5. Graph of the monthly average of Myrtaceæ pollen.

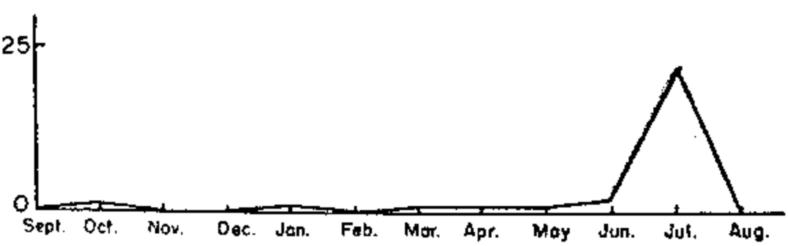

FIG. 6. Graph of the monthly average of Cyperaceæ pollen.

Figure 3. The plants that may be responsible for this are langka (*Atrocarpus heterophylla* Lam.), rimas (*A. communis* Forst.), and mulberry (*Morus alba* L.). Pollen grains of the family Urticaceae such as sandakot-na-bigas [*Pilea microphylla* (L.) Liebm.] are similar to this pollen type and may also account for this.

Leguminosae, with a total count of 67 pollen grains per sq cm, was next in abundance especially in March and its monthly pollen incidence is shown in Table 1 and Figure 4. The plants that may be responsible for this are the uncultivated plants such as ipil-ipil [*Leucaena leucocephala* (Lam.) de Wit], kakawati [*Gliricidia sepium* (Jacq.) Steud.], makahiya (*Mimosa pudica* L.), kamachile [*Pithecolobium dulce* (Roxb.) Benth.], pukinggan (*Clitoria ternatea* L.) and common ornamental plants such as alibangbang (*Bauhinia* spp.), caballero [*Caesalpinia pulcherrima* (L.) S.v.], fire tree [*Delonix regia* (Boh.) Raf.], sampalok (*Tamarindus indica* L.), dapdap (*Erythrina indica* Lam.), and narra (*Pterocarpus indicus* Willd.).

Myrtaceae was most abundant also in March since this is the flowering season of common fruit trees such as makopa [*Syzygium samarangense* (B.l.) Merr & Perr.], duhat [*S. cuminii* (L.) Skeels], and guava (*Psidium guajava* L.). Its monthly pollen incidence is shown in Table 1 and Figure 5 and it has a total count of 41 pollen grains per sq cm.

Cyperaceae ranked fifth, was most abundant in July and has a total annual count of 29 pollen grains per sq cm. Its peak in July as shown in Figure 6 is explainable by the abundance of mutha (*Cyperus rotundus* L.) and other sedges usually found in moist places.

Cruciferae was most abundnat in January and the most common members of this family are mustasa [*Brassica juncea* (L.) Coss.], radish (*Raphanus sativus* L.), and pechay (*Brassica chinensis* L.).

Casuarinaceae was abundant only in August and only in Station 3 and this was due to the presence of tall flowering agoho trees (*Casuarina equisetifolia* Forst.) around the building.

Amaranthaceae was found to be abundant in September which may be due to uray (*Amaranthus spinosus* L.) found in the vicinity. Otherwise, it was found sparingly throughout the year. Other species that may be responsible for this are cock's comb (*Celosia argentea* L.), botoncillo (*Gomphrena globosa* L.), cucharita (*Alternanthera versicolor* Regel), and colites (*Amaranthus lividus* L.).

Compositae was found abundantly only as a single mass on November 19-20. The most common composites are *Tridax procumbens*, bulakmanok (*Vernonia* spp., *Ageratum* spp.), sunflower (*Tithonia diversifolia* A. Gray), cosmos (*Cosmos caudatus* HBK.), dahlia (*Dahlia*

spp.), African daisy (*Gerbera jamesonii* Bolus.), marigold (*Tagetes erecta* L.), and sambong [*Blumea balsamifera* (L.) DC.].

A high incidence of unidentified pollens was observed from November to May (Table 1). These are types not found in the present collection of specimens or they may be a different optical view of already identified pollen types. A more intensive study and collection of representative specimens are necessary for identification.

DISCUSSION OF RESULTS

The pattern of pollen deposition in the Makati area, as a whole, from September 1968 to September 1969, is such that atmospheric pollen count which began at a low level in September increased gradually until it reached a maximum peak in November and declined and fluctuated downward the rest of the year.

The individual pollen types, on the other hand, showed different patterns in their deposition. Gramineae, exemplifying the general trend, was at a low level in September, rose to a maximum peak in November and declined continuously the rest of the year, reaching its minimum in May and June. Moraceae was not found on the slides until November and it fluctuated at a relatively high level from January to May then declined the rest of the year. This pattern was more or less similar to that of Myrtaceae. Leguminosae was nil in September, rose gradually until it reached the maximum in March and declined gradually the rest of the year. Cyperaceae was almost nil throughout the year except in July when it suddenly rose to a relatively high level.

These results are mainly influenced by the vegetation and the climatological factors that affect them. The most likely sources of atmospheric pollen grains are the plant species in the vicinity and pollen dissemination is affected by their habit, distribution, absolute pollen production and pollination calendar. In the Makati area, the most abundant sources of anemophilous pollen grains are the grasses and they are mainly responsible for the maximum peak in November. Besides being widely abundant, they produce a large amount of pollen and are adapted to wind pollination.

Plants have varying flowering periods during the year that may account for the variable patterns in pollen deposition. A knowledge of the pollination calendar enables us to point out the particular species that may be responsible for a high pollen count during a particular period. For example, in November, the most probable allergenic species is *Pennisetum polystachyon* (L.) Schult. since it is the most

abundant flowering grass during this period. Likewise, in July, Cyperaceae was the most abundant and this was probably due to *Cyperus rotundus* Linn. [Remo and Laserna (unpublished report)].

Climatological factors such as rainfall, humidity, temperature, wind velocity and direction and cloudiness also affect the amount of pollen in the atmosphere. Heavy rainfall and high humidity generally decrease atmospheric pollen count while warm temperature, sunshine and high wind velocity enhance it. Although each factor exercises its individual effect, their interaction determines the final result. The low count recorded in June may be due to heavy rainfall (Table 2) which prevents shedding of pollen, washes away the pollen from the air and destroys pollen which had been shed on the ground [Brown (1949)]. High humidity, too, may have the same effects. On the other hand, the warm temperature and sunshine in March may have stimulated pollination by drying out excess moisture thus increasing the buoyancy of the pollen]Derrick (1966)] and producing a greater number of pollination units [Faegri and Iversen (1950)]. Although high wind velocity enhances pollen count [Brown (1949)], the results do not show any significant relationship. It is also noticeable that pollen counts were high when the prevailing wind is from the southeastern direction (Table 2) and this may be due to the more abundant vegetation along this path.

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The authors are grateful to the building manager of Insular Life Building; to the Mayor of Makati and the Reverend Superior of Our Lady of Guadalupe Minor Seminary for allowing the use of their buildings; to the Maintenance Division of NIST for installing the Durham pollen samplers; to Mr. Delfin Castillo and Mr. Emiliano Villagracia who replaced the slides; to Mr. Domingo Madulid of the National Museum for checking the names of the plant species and to Mr. Jaime Banaag of U.P. for going over the manuscript.

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TABLE 2.—*Monthly summaries of meteorological observations made at Weather Bureau Forecasting Center from September 1968 to August 1969.*

	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.
Mean temperature (°C)	27.8	26.4	25.1	25.4	25.9	25.8	27.8	29.3	31.1	29.5	27.8	27.6
Mean relative humidity (per cent)	84	81	77	74	72	67	66	63	65	76	83	83
Total rainfall (mm)	325.2	101.9	16.3	T	0.3	T	7.9	0.2	6.9	124.0	385.5	284.4
Prevailing wind direction	W	SE	SE	SE	SE	SE	SE	SE	ESE	SW	SW	SE
Mean wind speed (Kts.)	6	3	4	5	6	8	8	9	7	6	5	5
Mean cloudiness	8	6	5	4	4	3	4	3	6	8	8	8

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FIELD SURVEY OF PROBABLE ALLERGENIC PLANTS IN THE MAKATI AREA, 1968-69

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ABSTRACT

A survey of grasses was undertaken in the Makati area to determine the probable allergenic species, their relative abundance and flowering periods. The widely predominant grasses found were *Eleusine indica* (L.) Gaertn. (yard grass) and *Dicanthium aristatum* (Poir.) C. E. Hubb. ((alabang x). The moderately predominant species was *Pennisetum polystachyon* (L.) Schult. (foxtail). The rarely predominant grasses were *Polytrias amaura* (Büse) O. Ktze. (java grass), *Echinochloa colonum* (L.) Link. (jungle grass), *Saccharum spontaneum* Linn. (talahib) and *Bothriochloa ewartiana* (Don.) C. E. Hubb. (delhi grass). There was an observed succession of dominant flowering grasses that can be attributed to the plants' inherent characteristics and the environment.

INTRODUCTION

Allergists have long recognized the need for a botanical survey in the treatment of pollen allergy. Pollens are seasonal allergens and a knowledge of the plants and their pollinating season is necessary for the patient to take precautions on time. For example, patients can minimize their pollen exposure by moving to another place during the pollinating seasons or taking extra precautionary measures such as sleeping with windows closed, riding with car windows closed or using window air-filters [Sheldon *et al* (1953)] and nose air-filters. Furthermore, a physician must know the approximate dates of the beginning, and maximum concentration of each type of important pollen so the patient can receive the maximum dose of protective antigen just a few days prior to the approximate time of his heaviest exposure to the pollen to which he is sensitive [Feinberg (1916)].

The Allergy Unit of the Medical Research Center, National Institute of Science and Technology, has started identifying the probable allergenic plants in the Philippines. The first botanical survey was conducted by Payawal and Laserna in 1961-62 in the Manila area [Payawal and Laserna (1965)]. The present botanical survey in the Makati areas is a continuation of the first one.

As in the survey of the Manila area, we have also limited our survey to grasses, these being widely abundant and their pollens being

anemophilous, produced in large quantities, and bouyant enough to be carried to far distances [Payawal and Laserna (1965)]. Extracts from their pollen have already been tested clinically and some have produced positive results [Vivera (1966)].

MATERIALS AND METHOD

The survey was conducted from July, 1968 to June, 1969. Makati was divided into 17 zones and in each zone, vacant lots were marked as collection stations. This zonification was done to delimit the area to be visited at one time and each area was visited at least 4 times a year or once every 3 months. These zones did not have equal areas but they were small enough to be adequately covered during one field trip.

During the survey, distribution of the flowering grasses were noted down and 3 classes of abundance were observed: 3, widely abundant; 2, moderately abundant; and 1, rarely abundant. This classification was based on the constitution of plant populations in the collection stations under study. Plants not readily identifiable in the field were collected and pressed for identification.

RESULTS

The ratings of each individual species, representing its abundance in the different collection stations, were added and the plants were ranked accordingly. The highest ranking plants were listed down and their distribution and duration of flowering tabulated as in Table 1. These plants were then classified according to their predominance throughout the year. Three categories based on the average distribution were established and these were as follows: (*a*) widely predominant

TABLE 1.—*Distribution of abundant flowering grasses from July 1968 to June 1969 in the Makati area* (1, *rarely abundant*; 2, *moderately abundant*; 3, *widely abundant*).

Common name	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan	Feb.	Mar.	Apr.	May	June	Average
Yard grass	2	2	2	2	2	2	2	2	2	1	3	3	2.1
Alabang X	1	1	1	1	1	3	3	3	3	3	2	1	1.9
Foxtail	—	—	2	3	3	2	2	2	2	2	1	—	1.6
Mutha	3	3	2	1	1	1	1	1	1	1	1	2	1.5
Java grass	—	—	—	—	2	3	3	2	—	—	—	—	.8
Jungle grass	3	3	1	—	—	—	—	—	—	—	—	1	.7
Talahib	—	1	3	3	1	—	—	—	—	—	—	—	.7
Delhi grass	—	—	—	—	1	3	1	—	—	—	—	—	.4

1.7 to 2.3; (*b*) moderately predominant 1.0 to 1.6; and (*c*) rarely predominant 0.3 to 0.9.

Thus, the widely predominant grasses in the Makati area were yard grass [*Eleusine indica* (L.) Gaertn.] and alabang-x [*Dicanthium aristatum* (Poir.) C. E. Hubb.]. The moderately predominant species was foxtail [*Pennisetum polystachyon* (L.) Schult.]. The rarely predominant species were java grass [*Polytrias amaura* (Büse) O. Ktze] jungle grass [*Echinochloa colonum* (L.) Link.], talahib (*Saccharum spontaneum* Linn.), and delhi grass [*Bothriochloa ewartiana* (Don.) C. E. Hubb.].

DISCUSSION OF RESULTS

The occurrence of grasses in an area is generally attributed to the climatic and edaphic conditions favorable for their growth [Good (1947) and Newbigin (1936)]. Makati, however, being a disturbed area, grasses may be considered to be the most successful colonizers of its uncultivated open areas. This is due to their capacity to endure urban conditions, and their ability to grow and reproduce rapidly.

There was an observable succession of dominant flowering grasses. From July to August jungle grass [*Echinochloa colonum* (L.) Link.], was the most abundant flowering species. Following this period, which was one, of profuse vegetative growth due to abundant rainfall, came the flowering of tall grasses, most abundant of which was talahib (*Saccharum spontaneum* Linn.). This was followed by the smaller species, foxtail [*Pennisetum polystachyon* (L.) Schult.]. In December, java grass [*Polytrias amaura* (Büse) O. Ktze] and delhi grass [*Botriochloa ewartiana* (Don.) C. E. Hubb.] flowered for a short period while alabang-x [*Dicanthium aristatum* (Poir.) C. E. Hubb.] which started flowering at the same period stayed throughout the dry season until May when vegetation became dried up. At the start of the rainy season, yard grass [*Eleusine indica* (L.) Gaertn.], which grows and flowers throughout the year, was the first to grow profusely in patches or small groups overshadowed by the rapidly growing and yet as quickly disappearing jungle grass [*Echinochloa colonum* (L.) Link.].

This succession can be attributed not only to the plants' inherent characteristics but also to man's activities. Grasses found in open areas have more or less definite flowering seasons but their growth is affected by periodic burning and mowing down in the area. Small grasses are given a chance to grow and flower profusely immediately after clearing although they are overshadowed later by the tall grasses.

Yard grass [*Eleusine indica* (L.) Gaertn.] and alabang-x [*Dicanthium aristatum* (Poir.) C. E. Hubb.] were found to be widely predominant in the area. This can be attributed not only to their abundant growth and wide distribution throughout the area but also to their longer period of abundant flowering.

During the survey, the distribution of mutha (*Cyperus rotundus* Linn.) a sedge, was also noted down because of its great abundance during the rainy season. Sedges are also anemophilous and can be considered as probable allergenic plants.

SUMMARY AND CONCLUSION

The survey of grasses undertaken in the Makati area shows that the predominant plants which are probable allergenic species are:

1. The widely predominant grasses, *Eleusine indica* (L.) Gaertn. and *Dicanthium aristatum* (Poir.) C. E. Hubb.;
2. The moderately predominant species, *Pennisetum polystachyon* (L.) Schult;
3. The rarely predominant grasses, *Polytrias amaura* (Büse) O. Ktze; *Echinochloa colonum* (L.) Link.; *Saccharum spontaneum* Linn.; and *Bothriochloa ewartiana* (Don.) C. E. Hubb.

There was an observed succession of dominant flowering grasses. This was attributed not only to the plants' hereditary characteristics but also to their environment.

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We would like to express our gratitude to the botanists of the National Museum especially Mr. Demetrio Mendoza and Mr. Domingo Madulid who helped in the identification of some specimens, to the drivers of NIST especially Mr. Maximo Decena, to Mr. Delfin Castillo and Mr. Emiliano Villagracia who accompanied us in the survey, and to Mr. Jaime Banaag of the Department of Botany, U.P. for going over the manuscript.

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THE ELIMINATION OF ALUMINUM INTERFERENCE IN THE ATOMIC ABSORPTION SPECTROPHOTOMETRIC DETERMINATION OF CHROMIUM BY HYDROXYLAMINE HYDROCHLORIDE

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ONE TEXT FIGURE

ABSTRACT

Aluminum in solution interferes in the atomic absorption spectrophotometric determination of chromium present in the solution as Cr (III) of dichromate ion. The use of hydroxylamine hydrochloride for the elimination of this interference is demonstrated. Experimental data are presented showing how aluminum depresses the absorption of Cr (III) and dichromate solutions and how small amounts of hydroxylamine hydrochloride restores the absorption to the level of aluminum-free solutions.

Aluminum in solution interferes in the atomic absorption spectrophotometric determination of chromium present in the solution as Cr (III) or dichromate ion. Although Wilson[1] reported that shifting from an air-acetylene to a nitrous oxide-acetylene flame avoids this interference, there has been no report so far on the chemical elimination of this interference by the use of releasing agents.

The present report concerns the use of hydroxylamine hydrochloride to remove aluminum interference in the AAS determination of chromium using an air-hydrogen flame. This novel use of hydroxylamine hydrochloride was stumbled upon in our search for a convenient reagent for reducing dichromate ion to Cr (III) prior to AAS analysis.

EXPERIMENTAL

Analytical reagent grade potassium dichromate and 99.99 per cent pure Chromium flakes (from Kern Chemical Company) were used to prepare the standard solutions. All other reagents were analytical reagent grade.

A Jarell-Ash model 82-516 atomic absorption spectrophotometer equipped with a total consumption burner was used with hydrogen at 4 psi as fuel and air at 20 psi as support gas. The chromium

[1] L. Wilson, Anal. Chim. Acta **40:** 503 (1968).

hollow cathode lamp was operated at 9 ma. In all determinations the Chromium emission at 357.9 mμ was used.

RESULTS AND DISCUSSION

Tables 1 and 2 show how the presence of aluminum depresses the absorption in both Cr (III) and dichromate solutions and that small amounts of hydroxylamine hydrochloride restores the absorption to the level of the aluminum-free solutions.

These tables also show that the percentage absorption in the Cr (III) solutions are higher than in the dichromate solutions even though presumably the chromium in both solutions ends up in the same oxidation state after it reacts with the reducing hydroxylamine hydrochloride. Table 2 shows that the addition of the hydroxylamine hydrochloride enhances slightly the absorption of Cr. (III) solutions.

TABLE 1.—*Effect of varying concentrations of $NH_2OH.HCl$ and aluminum on the absorption of 40-ppm chromium from dicromate in 0.5 N HCl.*

Per cent $NH_2OH.HCl$	ppm Al	Per cent absorption
0	0	60
0.1	0	62
0.5	0	62
1.0	0	60
2.0	0	60
0	200	50
0.5	200	61
1.0	200	62
2.0	200	61
0	400	47
0.5	400	56
1.0	400	60
2.0	400	62
0	500	49
0.5	500	55
1.0	500	59
2.0	500	61

TABLE 2.—*Effect of 0 per cent and 2 per cent NH_2 OH.HCl and varying amounts of aluminum on the absorption of 40-ppm Cr present as $CrCl_3$ in 0.5 N HCl.*

Per cent $NH_2OH.HCl$	ppm Al	Per cent absorption
0	0	74
2	0	81
0	200	60
0	400	62
2	200	81
2	400	80

The calibration curves for dichromate in 0.5 N HCl without any added reagents is identical to that with 2-per cent hydroxylamine hydrochloride and that with both 2-per cent hydroxylamine hydrochloride and 400-ppm Al. On the other hand, the calibration curve for Cr (III) in 0.5 N HCl with no other reagent added is considerably steeper than that for the dichromate. Moreover, in the presence of 2-per cent hydroxylamine hydrochloride, the Cr (III) curve becomes slightly steeper, but uninfluenced by the presence of 400-ppm Al. These calibration curves are all shown in Figure 1 and suggest that one ends up with different species when hydroxylamine hydrochloride is added to dichromate and to Cr (III).

Table 3 compares the behavior of hydroxylamine hydrochloride as a chemical releasing agent to that of three other commonly used releasing agents. Strontium and Lanthanum respectively depress and enhance the absorption of Al-free chromium solutions while the presence of aluminum reverses the effect. Thus neither releasing agent eliminates aluminum interference. Oxine depresses the percentage absorption of dichromate while it enhances very slightly that of Cr (III). Aluminum, however, increases this absorption in both kinds of solutions. Thus oxine does not eliminate the effects of aluminum. Only hydroxylamine hydrochloride among these removes the effect of added aluminum.

TABLE 3. — *Effect of different releasing agents on the absorption of 40-ppm Cr in 0.5 N HCl.*

None	0	72	52
Nnoe	400	57	39
2 Per cent $NH_2OH.HCl$	0	78	51
2 Per cent $NH_2OH.HCl$	400	77	51
0.5 Per cent $SrCl_2 6H_20$	0	57	35
0.5 Per cent $SrCl_2 6H_20$	400	63	47
0.23 Per cent $LaCl_3$	0	86	60
0.28 Per cent $LaCl_3$	400	67	47
2.5 Per cent oxine	0	76	43
2.5 Per cent oxine	400	82	52
5.0 Per cent oxine	0	77	44
5.0 Per cent oxine	400	82	53

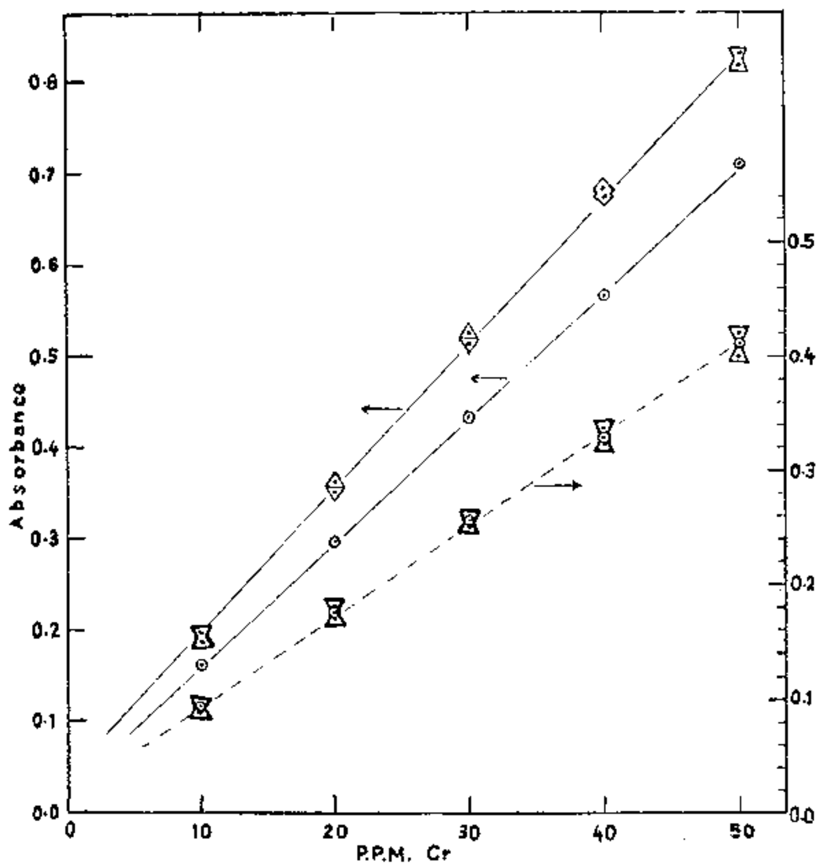

FIG. 1. — *Calibration curves of $CrCl_3$ and $K_2Cr_2O_7$*
Legend (———) $CrCl_3$ in 0.5 M HCl
(......) $K_2Cr_2O_7$ in 0.5 M HCl
○ no added reagent
△ 2 percent in $NH_2OH \cdot HCl$
▽ 2 per cent in $NH_2OH \cdot HCl$ and 400 ppm Al

THE FAMILY RANINIDAE AND OTHER NEW AND RARE SPECIES OF BRACHYURAN DECAPODS FROM THE PHILIPPINES AND ADJACENT REGIONS

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NINE PLATES AND 131 TEXT FIGURES

ABSTRACT

This paper is the second in the series of collaborative work between the UNESCO and the National Museum of the Philippines. Because of the well-known richness of the fauna of the Philippines, more extensive and intensive exploratory collections are as yet much to be desired. This is very clearly shown by the fact that, of the thirty one species studied, two genera, *Guinotellus* and *Peleianus* and four species, namely, *Cyrtorhina balabacensis*, *Parthenope (Rhinolambrus) sibmanensis*, *G. melvillensis*, and *P. suluensis* were new with the remaining species either second records or rediscoveries.

Aside from the materials in said National Museum of the Philippines, ten species from Japan, Singapore and Thailand, namely, *Ranilia orientalis* Sakai, *Ranilia misakiensis* (Sakai), *Notosceles serratifrons* (Henderson), *Paramedaeus planifrons* (Sakai), *Medaeus* (not *Medaeus*) *rouxi* Balss, *Goneplax ockelmanni* Serene, *Neoxenophthalmus obscurus* (Henderson), *Anomalifrons lightana* Rathbun, *Shenius anomalus* Shen, and *Camptandrium elongatum* Rathbun were also studied in order to provide a clearer understanding of the regional fauna as a whole. As a result, two new subfamilies are here established and one, discarded for a century, is revived.

This paper is the second in the series of collaborative work between the UNESCO and the National Museum of the Philippines. During the visits of the senior author to said museum in Manila, he found these interesting specimens of decapod crustaceans belonging to the Family Raninidae and many other brachyurans. Although all had been sorted out, the bulk was only provisionally identified and the rest unidentified.

The following is a checklist of the different species treated in this paper:

Subsection GYMNOPLEURA Bourne, 1922

Family RANINIDAE Dana, 1852

Subfamily NOTOPINAE novum

Ranilia orientalis Sakai, 1965[1]
Ranilia misakiensis Sakai, 1937[1]

Subfamily RANININAE novum.

Raninoides personatus Henderson, 1888
Raninoides hendersoni Chopra, 1933
Notosceles chimonis Bourne, 1922
Notosceles serratifrons (Henderson, 1888)[1]
Cyrtorhina balabacensis Serene, 1971

Subsection CORYSTOIDEA Dana, 1852

Family CORYSTIDAE DANA, 1852

Nautilocorystes investogatoris Alcock, 1889

Subsection OYXSTOMATA H. Milne Edwards, 1834

Family LEUCOSIDAE DANA, 1852

Subfamily EBALIINAE Stimpson, 1858

Oreophorus (Tlos) muriger Adams and White, 1848

Subsection BRACHYGNATHA Borradaile, 1907

Superfamily OXYRHYNCHA Latreille, 1803

Family PARTHENOPIDAE Miers, 1879

Subfamily PARTHENOPINAE Miers, 1879

Parthenope (Rhinolambrus) sisimanensis sp. nov.
Daldorfia spinosissima (A. Milne Edwards, 1862)

Family HYMENOSOMIDAE Stimpson, 1858

Elamenopsis lineatus A. Milne Edwards, 1873

Superfamily BRACHYRHYNCHA Borradaile, 1907

Family XANTHIDAE Alcock, 1898

Subfamily XANTHINAE Orthmann, 1898

Gumotellus melvillensis Serene, 1971
Medaeus elegans A. Milne Edwards, 1867
Medaeops granulosus (Haswell, 1882)
Paramedaeus simplex (A. Milne Edwards, 1873)
Paramedaeus planifrons (Sakai, 1965)[1]
Paramedaeus noelensis (Ward, 1942)

[1] Specimens from adjacent regions

Medaeus (not *Medaeus*) *rouxi* Balss, 1935 [1]
Calmania simodaensis Sakai, 1939

Subfamily PILUMNINAE Alcock, 1898

Peleianus suluensis Serene, 1971

Family GONEPLACIDAE Dana, 1852
Subfamily GONEPLACINAE Miers, 1896

Goneplax sinuatifrons Miers, 1886
Goneplax ockelmanni Serene, 1971 [1]
Notonyx nitidus A. Milne Edwards, 1873

Family XENOPHTHALMIDAE Stimpson, 1858
Subfamily XENOPHTHALMINAE Alcock, 1900 comb. nov.

Xenophthalmus pinnotheroides White, 1847
Neoxenophthalmus obscurus (Henderson, 1893) gen. nov [1]

Subfamily ANOMALIFRONTINAE Rathbun, 1929

Anomalifrons lightana Rathbun, 1929 [1]

Family OCYPODIDAE Ortmann, 1894
Subfamily CAMPTANDRINAE Stimpson, 1858 comb. nov.

Shenius anomalus (Shen, 1935)
Camptandrium elongatum Rathbun, 1929 [1]

Family GRAPSIDAE Dana, 1852
Subfamily VARUNINAE Alcock, 1900

Thalassograpsus harpax (Hilgendorf, 1892)

In spite of the well-known richness of the marine fauna of the Philippines, more intensive and extensive exploratory collections are still needed. This is well demonstrated by the fact that, of the 31 species studied, two genera and four species were new and several other species are either rediscoveries or second records.

Aside from the materials of the National Museum of the Philippines, 10 other species from Japan, Singapore, and Thailand, as indicated in the list, were also studied in order to provide a better understanding of the regional fauna as a whole.

We express our gratitude to Mr. A. E. Alfred, Acting Director of the National Museum of Singapore, for his kind permission in the use of the materials maintained in the collection of that Museum, without which the improvement of the position of the subfamily

Xenophthalminae and the genus *Camptandrium* would not have been possible.

Special acknowledgment is due Dr. T. Sakai who provided us with specimens of *Ranilia orientalis* and *Notopus misakiensis*. As a complement to our available materials, these two species enabled us to establish a new taxonomic frame for the family Raninidae.

All measurements in both the text and the illustrations are given in millimeters. As for the size of the specimens, the first number represents the length of the carapace; and the second its breadth. The drawings and photographs were taken by the senior author. Generally, the setae have been brushed off, although some were drawn in order to indicate the size. The catalog numbers preceded by the letters *NMP* refer to specimens in the National Museum of Philippines in Manila; *NMS*, those of the National Museum of Singapore; and *RS* are personal collections of the senior author. Thanks are due the Director of the National Museum of the Philippines for permission and authorization to deposit the type specimens of *Guinotellus melvillensis* and *Pelcianus suluensis* in the National Museum of Natural History in Paris, and to Dr. A. Wolf, Curator of the Zoological Museum of Copenhagen who provided reference materials for the critical study and determination of the type specimen of *Goneplax ockelmanni* which will be deposited in that Museum.

Subsection GYMNOPLEURA Bourne, 1922

Raniniens H. MILNE EDWARDS (1887) 190.
Raninoides DE HAAN (1841) 136.
Raninidea DANA (1852) 400; MIERS (1879) 46; HENDERSON (1888) 26.
Gymnopleura BOURNE (1922) 5; RATHBUN (1937) 6; BARNARD (1950) 396; Monod (1956) 47; TYNDALE-BISCOE and GEORGE (1962) 89; BENNETT (1964) 23; SAKAI (1965) 1.

Family RANINIDAE Dana, 1852

The family Raninidae is the only family under subsection Gymnopleura, and included in it are the following genera: *Ranina* Lamarck, 1801; *Raninoides* H. Milne Edwards, 1837; *Ranilia* H. Milne Edwards, 1837; *Notopus* de Haan, 1841; *Lyreidus* de Haan, 1841; *Cosmonotus* Adams and White, 1838; *Notopoides* Henderson, 1888; *Notosceles* Bourne, 1822; *Symethis*, Weber 1795; and *Cyrtorhina* Monod, 1956. The other genera are synonyms as follows: *Raninops* A. Milne Edwards, 1880 of *Ranila;* and *Zanclifer* Henderson, 1888 of *Symethis.*

The grouping of the genera in the several partial keys devised by Henderson (1888), Rathbun (1937), Sakai (1939), and Tyndale-Biscoe and George (1962), as well as the separation into species, were based

on morphological characters as follows: the size of the ischium in relation to the merus of the third maxilliped; the development of the antennular peduncle as to whether it conceals the antennula or not; the length of the flagellum of the antenna and the antennula; the direction of the eye peduncles when these are folded in the orbits; the fronto-orbital breadth and its ornamentation; the sternal thoracic shield; and the relative size of pereopod 5.

Based on the type of the male pleopods, the family Raninidae is separable into two new subfamilies; namely, Notopinae subfam. nov. which includes the genera *Cosmonotus*, *Notopus*, and *Ranilia*; and Ranininae subfam. nov. with the genera *Ranina*, *Lyreidus*, *Notopoides*, *Raninoides*, *Notosceles*, *Symethis*, and *Cyrtorhina* placed under it.

Key to the subfamilies and genera of the family Raninidae

1. Male pleopod 2 distally with a somewhat foliaceous, long and strong chitinous apical process which protrudes a little over the tip of pleopod 1. Eye peduncle folded strongly and obliquely downward and backward. Chelipeds with short flattened propodus; dactylus very short, bent against the anterior border of palm and fixed finger. An oblique rim on proximal portion of ischium of third maxilliped.

Notopinae subfam. nov. 2

Male pleopod 2 distally accuminate and ornamented at apex, shorter than pleopod 1. Eye peduncle folded almost transversely or longitudinally .... Ranininae subfam. nov. 4

2 (1). Rostrum present as a pointed triangular process 3

Rostrum absent, replaced by V-shaped incision. Antennal peduncle reaching far beyond carapace; antennal flagellum as long as peduncle. Eye peduncle slender, distinctly longer than half breadth of carapace. Carapace with median dorsal carina all along from front and backward. Margin of carapace with a single (extraorbital) spine on each side of rostrum; no anntero-lateral spine. Last pereopod not distinctly slender. Ischium of third maxilliped longer than merus. Size, 10.

Cosmonotus Adams and White, 1848

3 (2). Carapace with median dorsal carina on distal half; a transverse rim with spinules present between the two antero-lateral teeth, fronto-orbital border with only one suture and three spines on each side of rostrum (one intermediate, one extraorbital, the true extraorbital has disappeared, and one antero-lateral). Antennal flagellum somewhat longer than usual. Size ...... *Notopus* de Haan, 1841 *s. stricto*.

Carapace regularly convexed dorsally without transverse line between antero-lateral teeth. Fronto-orbital border with two sutures and four spines on each side of rostrum. Antennal flagellum shorter. Size, 40.

Ranilia H. Milne Edwards, 1837

4 (1). Eye peduncle with only one segment folded straight into orbit 5

Eye peduncle with three articulate segments bent at an angle to each other where it is retracted into orbit. Cheliped with short flattened

propodus and dactylus bent against its anterior border; fixed finger very short. In adult, extraorbital teeth bifid; two antero-lateral teeth trified. Ischium of their maxilliped shorter than merus. Size, 120.
Ranina Lamarck, 1801

5 (4). Chelipeds with propodus flattened and somewhat elongate, with dactylus bent against oblique, long fixed finger. Sternal thoracic shield relatively broad between articulation of pereopod 1 6

Chelipeds with propodus swollen or subcircular. Sternal thoracic shield nearly linear between articulation of pereopod 1 9

6 (5). Fronto-orbital border at least equal to or more than half breadth of carapace. Eye peduncle nearly transverse. Ischium of third maxilliped clearly longer than merus which is without proximal oblique sulcus ... 7

Fronto-orbital border clearly less than half breadth of carapace, at least 2.5 times extraorbital breadth. Eye peduncle directed nearly straight forward. Carapace 1.8 times as long as broad. Abdomen in males with acute tubercle on segment 3. Size, 45 ...... *Lyreidus* de Haan, 1841

7 (6). Carapace elongate, oval, 1.6 to 1.8 times as long as broad 8

Carapace ovate, markedly constricted at fronto-orbital level, 1.4 times as long as broad; extraorbital breadth subequal to half breadth of carapace. Antennal flagellum well developed. Size, 34.
Notopoides Henderson, 1888

8 (7). Fronto-orbital breadth more than half extraorbital breadth of carapace, or contained 1.4 times in the latter. Carapace 1.8 times as long as wide. Eye peduncle greatly exceeding length of rostrum. Outer lateral angle of merus of third maxilliped rounded. Sternal shield between pereopod 3 broad, never ilnear. Size, 30.
Raninoides H. Milne Edwards, 1834

Fronto-orbital breadth equal to half extraorbital breadth of carapace, or contained twice in the latter. Carapace 1.6 times as long as wide, Eye peduncle little exceeding length of rostrum. Sternal shield between pereopod 3, linear. Pereopod 5 less reduced and never remarkably slender. Size, 30 .... *Notosceles* Bourne, 1922

9 (5). Carapace elongate, oval; rostrum long; ischium of third maxilliped twice longer than merus; chelipeds without long spines on carpus and dactylus. Size, 25 .... *Symethis* Weber, 1795

Carapace broad, ovate: rostrum short; ischium of third maxilliped one third longer than merus; cheliped with very long acute spines on carpus and dactylus. Size, 28 .... *Cyrtorhina* Monod, 1956

This paper includes a review of the genera *Ranilia, Raninoides, Notosceles,* and *Cyrtorhina.* The genera *Cosmonotus, Ranina,* and *Notopoides* are each represented by only one species, and only known from the Indo-Pacific region. We consider *Notopoides* as close to *Raninoides* to which further comments will be made in the succeeding pages.

The genus *Symethis* occurs only in the Atlantic and is known from only one species. The genus *Lyreidus* which is essentially Indo-Pacific, but with one Atlantic species, needs further revision.

Regarding *L. channeri*, our brief remarks will be found in the comments on the different species of *Raninoides*.

The male pleopods 1 and 2.—The male pleopods of the following species are known:

Cosmonotus grayi by Barnard [(1950) fig. 51, i)]; Tyndale-Biscoe and George [(1952) fig. 8, 1]
Notopus dorsipes by Tyndale-Biscoe and George [(1962) fig. 8, 4]
Notopus (=*Ranilia*) *ovalis* by Tyndale-Biscoe and George [(1962) fig. 8, 3a, b]
Ranilia orientalis (present paper)
Notopus (=*Ranilia*) *misakiensis* (present paper)
Ranina ranina by Barnard [(1950) fig. 7c-d]; Tyndale-Biscoe and George [(1962) fig. 8, 3a, b]
Notopoides latus by Gordon [(1966) fig. 4 a-c]
Raninoides personatus (present paper)
Raninoides hendersoni (present paper)
Raninoides bouvieri by Monod [(1956) fig. 33, 34]
Raninoides (=*Notosceles*) *serratifrons* by Barnard [(1950) fig. 7, g]
Notosceles chimmonis (present paper)
Lyreidus integra by Sakai [(1937) fig. 38, as *L. politus*]
Lyreidus tridentatus by Sakai [(1937) fig. 41]

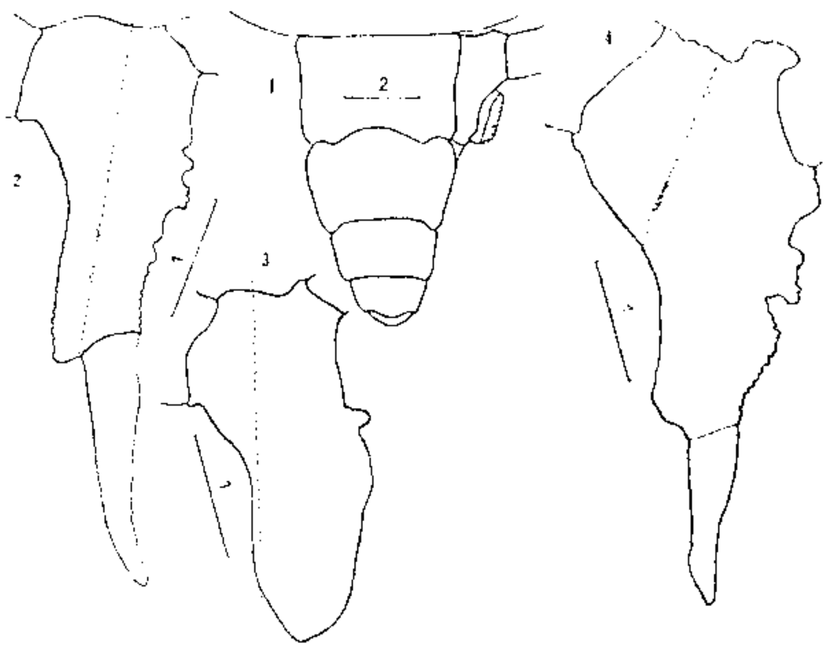
All these pleopods differ from the typical brachyuran pleopods and are instead close to those of Dromiacea and Tymolidae. The first distinct difference is the fusion and elongation of the basal segment of the two pleopods, which may be attributed to the dorsal position of periopods 4 and 5. It also appears that these pleopods, on the basis their distal parts (terminal segment) belong to two different types mainly as regards the apex of pleopod 2. In one type, pleopod 1 is a hollow, folded, leaflike structure and pleopod 2 is broad until its tip and almost as long as pleopod 1. In the other type, it does not differ very much from the typical brachyuran pleopod 1 while pleopod 2 is tapering, accuminate, and distinctly longer than pleopod 1.

In this paper, the first type is used in defining the subfamily Notopinae; and the second, in delimiting the subfamily Ranininae, in which the tips of the pleopods are generally fitted into the sulcus of the sternal shield but never in Notopinae.

In Dromiacea, pleopods 1 and 2 in the family Homolidae (*Homola orientalis, Paramola boasi*, e. g.) are almost similar but not identical to those of the Notopinae; although in the latter, the apex of the distal segment is narrower and does not resemble "the sole of a boot" as it is in Homolidae. The pleopods of Dromiidae (*Conchoecetes adamanicus, Cryptodromia areolata, Dromidiopsis cranioides*) [Monod (1956) fig. 50, and 51, for *Dromia caputmortuorum*, fig. 70 and 71, for *Dromia nodosa*] are close to that of Ranininae.

In Tymolidae ("peditremen" Dorippidae), two different types of pleopods also exist — the Tymolae type [*Tymolus japonicus*, Gordon (1963) fig. 11 A] which corresponds closely to the family Dromaiidae and the subfamily Raninae; and the Cymonomae type [*Cymonomus granulatus*, Gordon (1963) fig. 11 B] which pertains to the family Homolidae, and in some respects to the subfamily Notopinae. The Notopinae type differs from the Cymonomae type in that the apex of pleopod 2 is not widened "like the sole of a boot" in the words of Gordon. In short, there exists two types in the three taxa (Dromiacea, Tymolidae, and Gymnopleura), namely, the acuminate type [hypodermic needle type of Gordon (1963)] for Dromiidae, Tymolinae, and Ranininae; and the broad type for Homolidae, Cymonomae, and Notopinae.

The coxa of pleopod 5 in the male of Raninidae (Text figs. 1, 2, and 4) presents a long process (like an elongated plate on its posterior border) which is distally terminated by the semirigid penis. As a



FIGS. 1-4. Copulatory organs: *1*, penis at right pereopod 5 *in situ* in relation to abdomen and carapace in male *Raninoides personatus*, size 20 x 8; *2*, penis of left pereopod 5 in same specimen; *3*, coxal plate in female, size 31 x 12 of same species; *4*, penis in a male *Notosceles chimonis*, size 33 x 16. The dotted lines indicate the border of the abdomen.

result, the coxa is much broader than long. In the natural condition, this coxal process is partly covered by the outer border of abdominal segment 1 and is partly visible like a plate covering the coxa of pereopod 4. The penis is always concealed under the outer border of th abdominal segment 2. In *Raninoides*, the coxal process is comparatively more developed and less concealed under the abdomen than in *Notosceles*. It is almost obsolete in *Notopoides*. Such a greater development seems to be related to the breadth of the abdominal segment in relation to the breadth of the posterior border of the carapace. In the females, (Text fig. 3) the coxal plate is comparatively less developed than in males.

Gordon (1963) makes mention and illustrates the existence of "a large penial projection on the coxa of pereopod 5" in *Cymonomus* and in *Tymolus*. According to her figures (Fig. 11), the penial projection of the coxa is relatively short (longer than broad) and is never as developed as in Raninidae. In Dromiacea, the penis is free and is bent along the sternal shield; and there is no coxal process at all.

These links between Gymnopleura, Dromiacea, and Tymolinae confirm the well known aberrant situation of those "peditremen" Brachyura in the actual classification. When Bourne (1922) established Gymnopleura, and stressed (among others in the reference) on the nervous system, he intended to show that the links of the taxon are closer to Macrura and Hippidea (in Anomura) than to Brachyura including Dromiacea and Corystidea. Gordon (1963) stressed more accurately the coxal position of the female genital opening in order to suggest that improved classification of Crustacea-Decapoda should exclude the Gymnopleura as well as Dromiacea and Tymolidae from Brachyura *sensu stricto*. Our observations on the male sexual appendages of Raninidae support the views of Gordon (1963, 1966).

Subfamily NOTOPINAE novum

Definition.—Eye peduncle folded strongly downward and obliquely backward. Chelipeds with short flattned propodus; dactylus bent against anterior of palm; fixed finger very short. An oblique rim on proximal part of ischium of third maxilliped. Pleopod 2 in male with long chitinous apical process distally exceedng a little the somewhat foliaceous tip of pleopod 1.

The type genus of the subfamily is *Notopus* de Haan, 1841, and *Notopus dorsipes* de Haan, 1841, the types species. Also included in this subfamily are two other genera, namely, *Cosmonotus* Adams and White, 1848 and *Ranilia* H. Milne Edwards, 1837.

Notopinae type of male pleopod.—The description of male pleopods 1 and 2 of *Ranilia orientalis* is given as reference description

instead of *Notopus dorsipes* because of its much larger size.

The typical brachyuran type of pleopod 1 has two segments which, according to the terminology of Tyndale-Biscoe and George [(1962) fig. 1], are known as "basal segment" and "shaft," the latter referring to the distal segment.

The basal segment is generally short, situated close to abdominal segment 1. The proximal portion of the two basal segments of the pair of pleopods are most often medially united somehow, although they can also be separated from each other. The term "basal segment" actually includes from two to three united segments. In pleopods of Gymnopleura and Dromiacea, the distal part of the basal segment, where the pair is not fused to each other, is divided into at least two distinct and articulate segments. These distal parts of the two latter segments are elongate and usually as long as the "shaft."

In the brachyuran type of pleopod 1, emphasis is always given to the "shaft" and its apex although the separation of the basal segment into from 2 to 3 distinct structures is sometimes shown in illustrations of authors. The "shaft" is characterized by the presence of a "proximal aperture," a "distal aperture," and a more or less clear "ridge" which joins these two apertures. The proximal aperture corresponds to the region where pleopod 2 is generally intruding into pleopod 1. When pleopod 2 is clearly longer than pleopod 1 (Menippinae type, and *Carcinoplax* e. g.), its distal part far exceeds the "distal aperture."

In pleopod 1 of Notopinae, only the distal segment corresponds to the "shaft." The very wide open "proximal aperture" communicates with the distal aperture by also a wide open "gutter." The two lateral borders of the "shaft" are only slightly curved inward without one joining the other. The rim, which in brachyura type corresponds to their junction, is replaced by this wide open "gutter." Pleopod 1 is densely ornamented with long setae on its basal segments as well as in its shaft. The tegument is only slightly calcareous and in some parts of the shaft it is parchmentlike. The inner face of the shaft differs from its outer face as shown in illustration of the inner face of *R. orientalis* (Text fig. 5) and of the outer face of *R. misakiensis* (Pl. 2B).

Pleopod 2 has at least 2 basal segments and one distal, the latter much longer than the former and a little longer than the total length of the basal segment and shaft of pleopod 1. This distal segment is divided into a proximal part with calcareous tegument and a distal part completely composed of a brown (natural coloration) chitinous

process. The whole distal segment, including the two parts corresponds to the "shaft" of pleopod 2 in other Brachyura. Such pleopod 2 which is a little longer than pleopod 1 is closer to, though still very different from, he Menipinae type than to the Pilumninae type. This pleopod 2 has a lateral salient apohyse which seems to indicate the limit of the portion which does not intrude into pleopod 1. Pleopod 2 in Notopinae has at least the shaft completely bare, in contrast to pleopod 1.

On the generic and specific levels, the chitinous distal process of pereopod 2, which is a very complex structure, will probably provide some differentiating characters. On the contrary, pleopod 1 seems to be almost similar in all members of the subfamily.

The present description is valid only at the subfamily level. The description of the male pleopods of Ranininae at the generic and species levels will be reserved for a later discussion. It is sufficient to state that at the generic level, only little differences were observed among *Ranila, Notopus,* and *Cosmonotus.* See figures of Tyndale-Biscoe and George [(1962) fig. 1, for *C. grayi* and figs. 3 and 4.

aff. Genus **RANILIA H. Milne Edwards, 1837.**

Ranilia, H. MILNE EDWARDS (1837) 195; RATHBUN (1937) 17; MONOD (1956) 47; SAKAI (1965) 2.

Raninops A. Milne Edwards (1880) 34.

Remarks.—The genus was established for *muricata,* a species from the Caribbean Sea and the Atlantic Coast of America. It includes another species, *constricta,* also of the Atlantic-American coast, together with two other species, *angustata* and *fornicata* of the Pacific Coast of America, and further still another, *atlantica* from the Atlantic-African coast. Sakai (1965) described *R. orientalis* as the first species from Asian seas.

By referring to written works of various authors but without comparing actual specimens, we found that the difference in the shape of the dactylus of the pereopods is the only basis to justify the separation of the species *orientalis* from the genus *Ranila.* According to Rathbun (1937), the dactyli of pereopods 2-4 of *R. muricata* (type species) are triangular, while the dactylus of pereopod 4 of *R. orientalis* is truncate. Perhaps, some other differences could be found to justify the removal of the Indo-Pacific species from *Ranilia* and the creation of a new genus. In this work, we use *aff. Ranilia* in order to imply our reserved opinion on the subject.

A comparative examination of specimens of *Ranilia orientalis* and *Notopus misakiensis* shows that the species are congeneric. Probably, the same is true with *Notopus ovalis.* Sakai (1965) states that in both *orientalis* and *misakiensis,* there is a distal process on the posterior border of the carpus of pereopod 4. Such a process is apparently present in *R. muricata, R. stimpsoni* (=*constricta*), and *Notopus dorsipes.*

The genus *Notopus* is maintained for the single species, *Notopus dorsipes. Notopus, s. stricto* differs from *aff. Ranilia* in the following characteristics: (*1*) the distribution of the spines on the fronto-orbital margin; (*2*) the structure of the anterior part of the dorsal surface of the carapace with its median carina and transverse spinulous rim; (*3*) the much longer antennal flagellum; (*4*) the dactylus of pereopod 4 with a straight anterior border and the regularly convex posterior border; and (*5*) the basal antennal segment without any antero-lateral process on the external side.

Notopus and *Ranilia* (as well as *aff. Ranilia*) have, in common, the obliquely downward and backward directed orbits; the third maxilliped with the merus shorter than the ischium; and the oblique sulcus on the proximal part of the ischium.

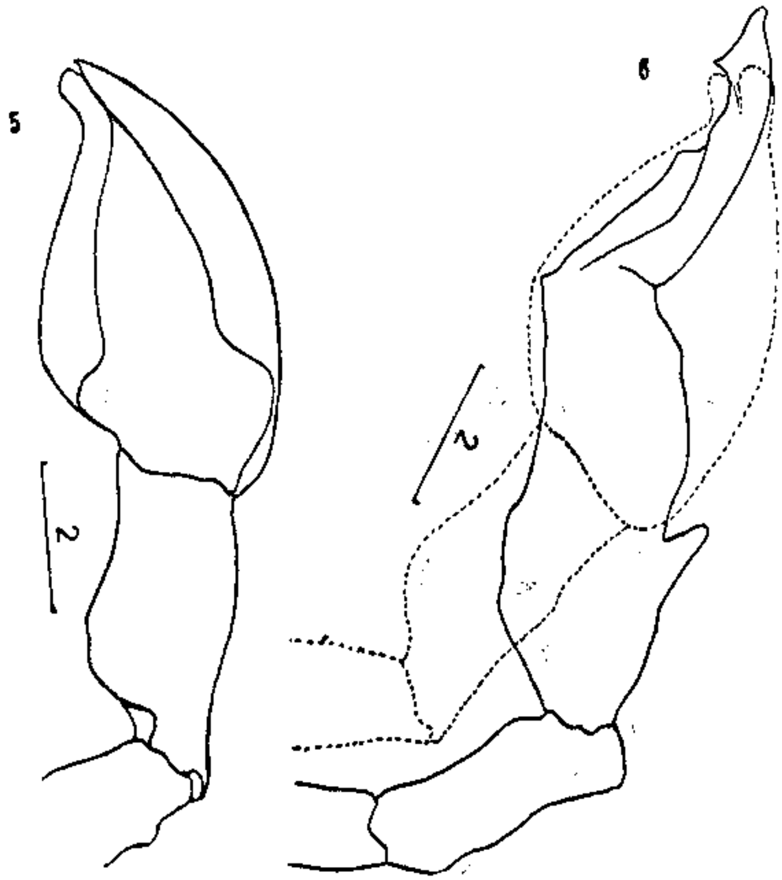
We place *orientalis* Sakai, 1965, *misakiensis* Sakai, 1939, and *ovalis* (Henderson, 1888) under *aff. Ranilia,* and as a complement to the present observations on the genus, the use of one specimen of *orientalis* and one of *misakiensis* for the present review and for the illustrations are placed on record. The last species, *ovalis* was described by Henderson (1888) based on a single specimen (size 8.7 x 11.7) collected off Ki Islands at 140 fathoms. Yokoya (1933) recorded four males and one female from Japan (50-200 m) without indicating the sizes, and Sakai (1937) only made reference to Yokoya's records. Tyndale-Biscoe and George (1962) recorded two males (sizes, 26.2 and 23.2) and one female (size 21.8) taken from the west coast of Australia.

RANILIA ORIENTALIS Sakai. **Plate 1, figs. 1-5; Text figs. 5-6.**

Ranilia orientalis SAKAI (1963) 226. text fig. 6; SAKAI (1965) 2. Pl. 1, fig. 3.

Material.—Male, size 43 x 30, off Mikawa Bay, Japan, Sakai collection and determination.

Remarks.—This species which is endemic to Japan is commonly trawled from the bottom at 50 to 120 meters below the surface.



FIGS. 5-6. Male pleopods in the subfamily Notopinae as in *Ranilia orientalis*, size 43 x 30; *5*, pleopod 1; *6*, pleopod 2, the dotted line showing the outline of pleopod in natural position.

This specimen is one of those (nine males and seven females) recorded by Sakai (1965).

RANILA MISAKIENSIS (Sakai), 1937. Plate 1, figs. 6-10; Plate 2, figs. 1-5.

Notopus misakiensis SAKAI (1937) 176, text fig. 44; SAKAI (1965) 2, Pl. 1, fig. 2.

Material.—Male, size 37 x 29, Kii Nagashima, Mie, Japan, Sakai collection and determination.

Remarks.—This species which is endemic to Japan is described from a holotype female (size 33 x 26) collected from Misaki at a depth of 100 to 150 meters. This specimen is one of those (two males and one female) recorded by Sakai (1965). The principal differences of

R. misakiensis from *R. orientalis* are: (*1*) the broader carapace, the length 1.27 in the widest breadth in the former species, and 1.43 in the latter; (2) the narrower extraorbital breadth, 2.56 between the anterolateral spines in *misakiensis* and 1.42 in *orientalis*.

Subfamily RANININAE novum

Definition.—Eye peduncle folded almost transversely or obliquely or almost longitudinally forward. Male pleopod 2 regularly tapering toward its tip and with an elongated tapering shaft, shorter than pleopod 1.

The type genus of the subfamily is *Ranina* Lamarck, 1801, with *Cancer ranina* Linnaeus, 1885, as the type species. In the Rnaninae type of male pleopod, the basal segments of pleopods 1 and 2 are similar to those of the Notopinae type although the shafts of both pleopods 1 and 2 are similar to those of the brachyuran type.

The Ranininae includes the following genera: *Ranina* Lamarck, 1801, *Lyreidus* de Haan, 1841, *Notopoides* Henderson, 1888, *Raninoides* H. Milne Edwards, 1834, *Notosceles* Bourne, 1922, *Symethis*, Weber, 1795, and *Cyrtorhina* Monod, 1956. The subfamily is heterogenous, and the genera composing it may be separated into the following four groups:

Group 1. Characterized by eye peduncles with three segments folded one against the other; palm of cheliped similar to that of Notopinae .... *Ranina*

Group 2. Characterized by nearly transverse eye peduncles; palm of cheliped with much longer fixed finger and with different structure .... *Raninoides, Notopoides, Notosceles*

Group 3. Characterized by eye peduncles which are almost longitudinal; palm of cheliped similar to that of Group 2; male pleopod 1 different from other groups .... *Lyreidus*

Group 4. Characterized by an entirely different type of cheliped, although male pleopod 1 resembles that of Group 2. *Symethis, Cyrtorhina*

Actually, each of these groups can justify the establishment of distinct subfamilies, thus delimiting Ranininae only to the genus *Ranina*.

Genus RANINOIDES H. Milne Edwards, 1837

Raninoides H. MILNE EDWARDS (1837) 196; DANA (1852) 403; HENDERSON (1888) 27; BOURNE (1922) 73; RATHBUN (1937) 7; MONOD (1956) 54; TYNDALE-BISCOE and GEORGE (1962) 2.

Raninoides (partim) HENDERSON (1893) 403; ALCOCK (1896) 292; IHLE (1918) 317; STEBBING (1920) 294; CHOPRA (1933) 81; SAKAI (1937) 165; SAKAI (1965) 2.

History and discussion.—The type of the genus is an Atlantic species, *Ranina laevis* (Latreille, 1825). Three Indo-Pacific species have been included, namely, *personatus* Henderson, 1888, *serratifrons* Henderson, 1893, and *hendersoni* Chopra, 1933. As Bourne (1922) suggested, and because of the shape of the apex of the male pleopod 1 [Barnard (1950) fig. 75 g] we assign *serratifrons* to the genus *Notosceles.*

There is no available information on the male pleopod of *laevis,* the type species. However, the pleopods of *bouvieri* [Monod (1956) figs. 33 and 34] are identical with those of *personatus* and *hendersoni.*

In the following key, all the Indo-Pacific species of *Raninoides* and *Notosceles* have been included because the separation of these two genera is still uncertain.

Key to the Indo-Pacific species of the genera Raninoides and Notosceles

1. Process on each side of sternal plate between basal joint of pereopods 1 and 2, acute; propodus of cheliped with one subdistal spine without indication of double crested carina; carpus with two subdistal spines; ischium with a strong spine on anterior border .... *Raninoides,* 2
   No acute process on each side of sternal plate between basal joint of pereopods 1 and 2; propodus of cheliped with a double crested carina along superior border; carpus with or without a pair of distal (no subdistal) spines: eye peduncles stouter and shorter than in *Raninoides.* *Notosceles,* 3

2 (1). Antero-lateral process of sternal plate between pereopods 1 and 2 acutely pointed; carapace elongate 1.9 to 2 times as long as broad; supraorbital fissure somewhat broad with acute median lobe; postfrontal region not covered by acute granules; superior border of palm of cheliped nearly smooth with a subterminal spine; carpus smooth with two distal spines, the outer somewhat larger; fixed finger broad at base; ischium of pereopod 2 wthout spine; ischium of maxilliped 3, 1.49 times longer than merus .... *R. personatus*
   Antero-lateral process of sternal plate between pereopods 1 and 2 less acute and shorter; carapace broader, 1.7 times as long as broad; supraorbital fissures deeper and narrower with squarish median lobe; post frontal region ornamented with acute granules beyond line connecting lateral teeth. Superior border of palm of cheliped slightly spinulous with a subterminal spine; carpus spinulous with two distal spines; fixed finger narrower; a spine on ischium of pereopod 2; ischium of maxilliped 3, 1.42 times longer than merus .... *R. hendersoni*

3 (1). Rostrum without lateral (inner supraorbital) teeth; sternal shield somewhat narrower 4
   Rostrum tridentate with a pair of lateral teeth; sternal plate very narrow. Carapace 1.66 times as long as broad; breadth of carapace 2.1 times extraorbital breadth. Propodus of cheliped with 2 spines on inferior border; carpus without spine; ischium of maxilliped 3, 1.59 times longer than merus .... *N. chimonis*

4 (3). Carapace 1.54 times as long as broad; breadth 2.1 times extraorbital breadth. Propodus of cheliped with 3 to 4 spines on inferior border and one distal spine on superior border; carpus with two (at least one well developed) distal spines. Dactyli of pereopod 3 straight, of pereopod 4, falciform .... *N. viaderi*

Carapace 1.8 times as long as broad; its breadth 1.7 to 1.8 times extraorbital breadth. Propodus of cheliped with 3 to 4 spines on inferior border; carpus with sharp granules on dorsal surface and a distal pair of spines situated side by side, and inner much larger. Dactyli of pereopod 2 to 4 slightly sickle-shaped. Ischium of maxilliped 3, 1.76 times longer than merus .... *N. serratifrons*

Remarks on Lyreidus channeri.—*R. nitidus* A. Milne Edwards, 1880, one among the eight non-Indo Pacific species of *Raninoides*, is aberrant because of the presence of two lateral spines behind the extraorbital teeth as observed by Henderson (1888) and Chopra (1933). The Indo-Pacific species *Lyreidus channeri* Wood-Mason, 1885, differs from all the other species of *Lyreidus* also by the presence of two lateral spines behind the extraorbital teeth; by the short and stout eye peduncle; and by some other characters. Probably *R. nitidus* and *L. channeri* belong to the same genus. A comparison of the illustrations of *channeri* by Alcock (1900, Pl. 73), and those of *nitidus* by Rathbun (1937, Pl. 2, figs. 1-2), shows the following similarities: (*1*) the antennae and the antennulae are well developed; (2) the ischium of the maxilliped is somewhat shorter than the merus, at least in *nitidus* (Rathbun (1937, Pl. 2, fig. 2), and there is no such similar information available for *channeri*. At most, this specific character 2 of the merus is insufficient ground to justify the inclusion of *nitidus* in *Raninoides*, the latter with an ischium definitely shorter than the merus. We would rather think that the two species belong to another new genus closer to *Lyreidus* than to *Raninoides*. It would be interesting to know if the acute tubercle which characterizes *Lyreidus* and which is not mentioned by authors, is present on the abdominal segment 3 of *L. channeri*.

Remarks on Notopoides Henderson, 1888.—*Notopoides latus* Henderson, 1888, the only species of the genus, has a closer affinity to *Raninoides* and *Notosceles* than to *Notopus* because of the following characteristics: (*1*) the structure of the palm and fingers of the chelipeds; (2) the absence of oblique ridge on the ischium of the third maxilliped; (*3*) the eye peduncle which are not strongly directed downward and backward; (*4*) the deep supraorbital sulci; and (*5*) the presence of the transverse rim behind the front connecting the lateral teeth. The male pleopods 1 and 2 of *Notopoides latus* (Gordon, 1966, figs. 4 A-C) are close to those of *Raminoides* and *No-*

tosceles, which show that the genus *Notopoides* belongs to Ranininae rather than to Notopinae in spite of the name.

RANINOIDES PERSONATUS Henderson, 1888. Plate 2, figs. 6-8; Text figs. 7-14, 31.

Raninoides personatus White MSS.: HENDERSON (1888) 27, Pl. 2, fig. 5; ALCOCK (1896) 293; IHLE (1918) 317; BOURNE (1922) 73, Pl. 4, figs. 5-6; Pl. 6, figs. 36-37; Pl. 7, figs. 48-50, 58; CHOPRA (1933a) 52; CHOPRA (1933b) text fig. la, Pl. 3, figs. 2-2a; YOKOYA (1933) 113; SAKAI (1937) 167; SAKAI (1940) 46; TYNDALE-BISCOE and GEORGE (1962) 92.

Material.—NMP 1477, two males, size 18 x 9 and 19 x 9.5, North of Walan Island (Pele Sulu Sea Expedition, 1964) in 50 to 51 fathoms; NMP 814, two males, size 21 x 11 and 13 x 6.5, Cape Calavite; NMS 1968. 1.25.15 male, size 20 x 10; NMS 1968. 1.25.15 female, size 31 x 12, Indonesia.

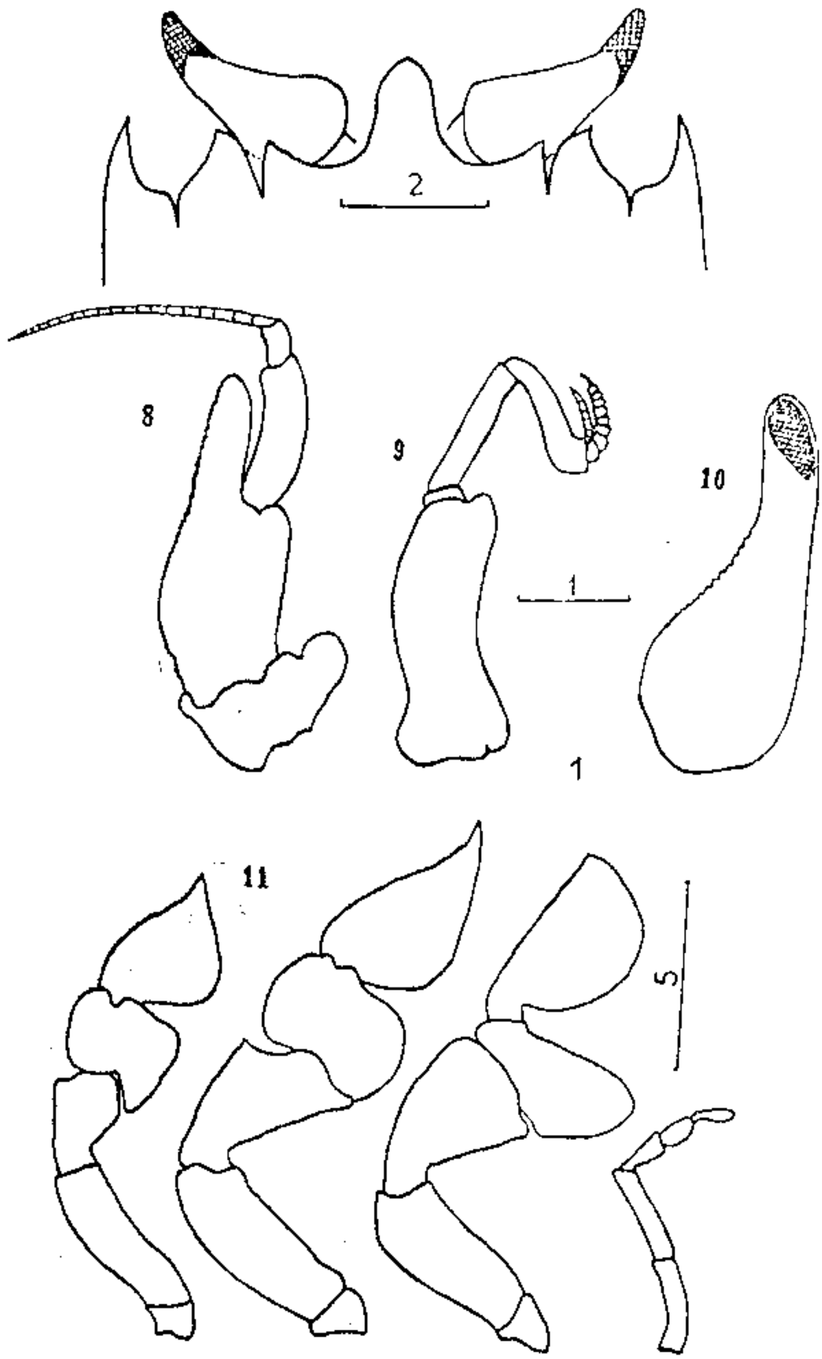
History and remarks.—Henderson (1888) described a male specimen, size 23.5 x 12.7 from Amboina. He stated that specimens from the Eastern Seas which were named but never described by Adams and White are maintained in the collections of the British Museum. Alcock (1896) recorded numerous specimens from the coasts of the Bay of Bengal, collected in from 12 to 70 fathoms which are maintained in the Indian Museum Collection. Ihle (1918) only quoted the species in his list. Bourne (1922) illustrated one specimen from the Bay of Bengal.

Chopra (1933a) recorded four females, the largest of which has a carapace length of 27, and one male of 23 from the Bay of Bengal, and stated further that this species is common in the locality. He also recorded two specimens from Burma Coast. Yokoya (1933) recorded the species in Japan and Sakai (1937) only referred to the records of Yokoya. Tyndale-Biscoe and George recorded one ovigerous female, with a carapace length of 29.8 collected from Australia in 22 fathoms of muddy bottom.

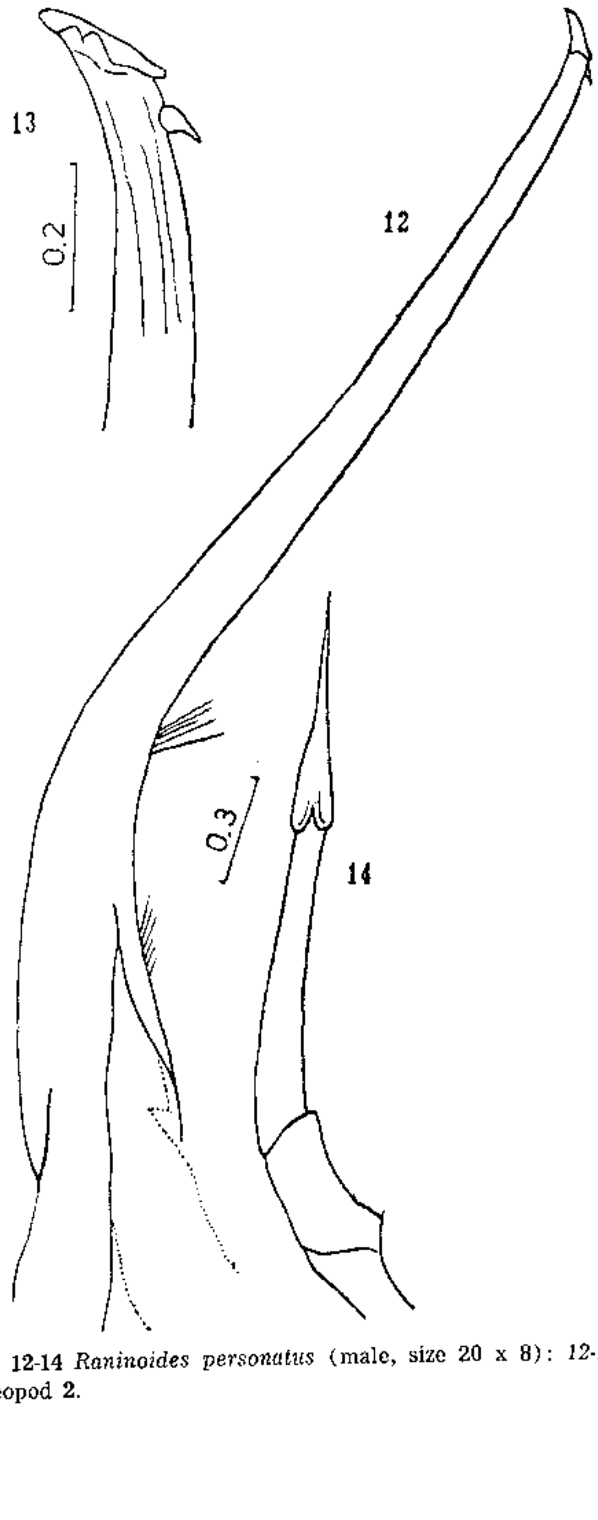
Henderson (1888) wrote: "The anterior pair of genital appendages are long and their terminal joint curved, the second pair less than half the length of the first." As illustrated in this paper, pleopod 2, in the natural condition, is inserted in pleopod 1. Pleopod 1, also in natural condition, reaches far beyond the distal margin of the abdomen. Its distal part is fitted in a median longitudinal sulcus of the sternal plate which is not true with the females.

RANINOIDES HENDERSONI Chopra, 1933. Plate 3, figs. 1-3; Text figs. 15-22, 32.

Raninoides hendersoni CHOPRA (1933) text fig. 1, Pl. 3, figs. 1-1a.



FIGS. 7-11. *Raninoides personatus* (male, size 20 x 8): *7*, fronto-orbital border; *8*, antenna; *9*, antennula; *10*, eye peduncles; *11*, pereopods 2-5.



FIGS. 12-14 *Raninoides personatus* (male, size 20 x 8): *12-13*, pleopod 1; *14*, pleopod 2.

Materials.—NMP 1371, two males, sizes 19 x 11 and 18 x 10.5, off Loay Island, Bohol, in 45 fathoms by Pele Sulu Sea Expedition, 1964.

History and observations.—Chopra (1933) described *hendersoni* on a single female, size 17 x 10.1, from the Andaman Sea and collected at 11° 49' 50" N., 92° 52' E. at a depth of 55 fathoms in April, 1898 by the HMS "Investigator." The holotype (Cat. No. 2640/10), which was originally identified by Alcock as "*Raninoides personatus* White, variety," is maintained in the Zoological Survey of India (Indian Museum).

The main differences between *hendersoni* and *personatus* are contained in the aforegoing key to Indo-Pacific species of *Raninoides* and *Notosceles*. Pleopod 1 in males of this species are close to that of *personatus*. The present record of the species from the Philippines extends its geographical distribution.

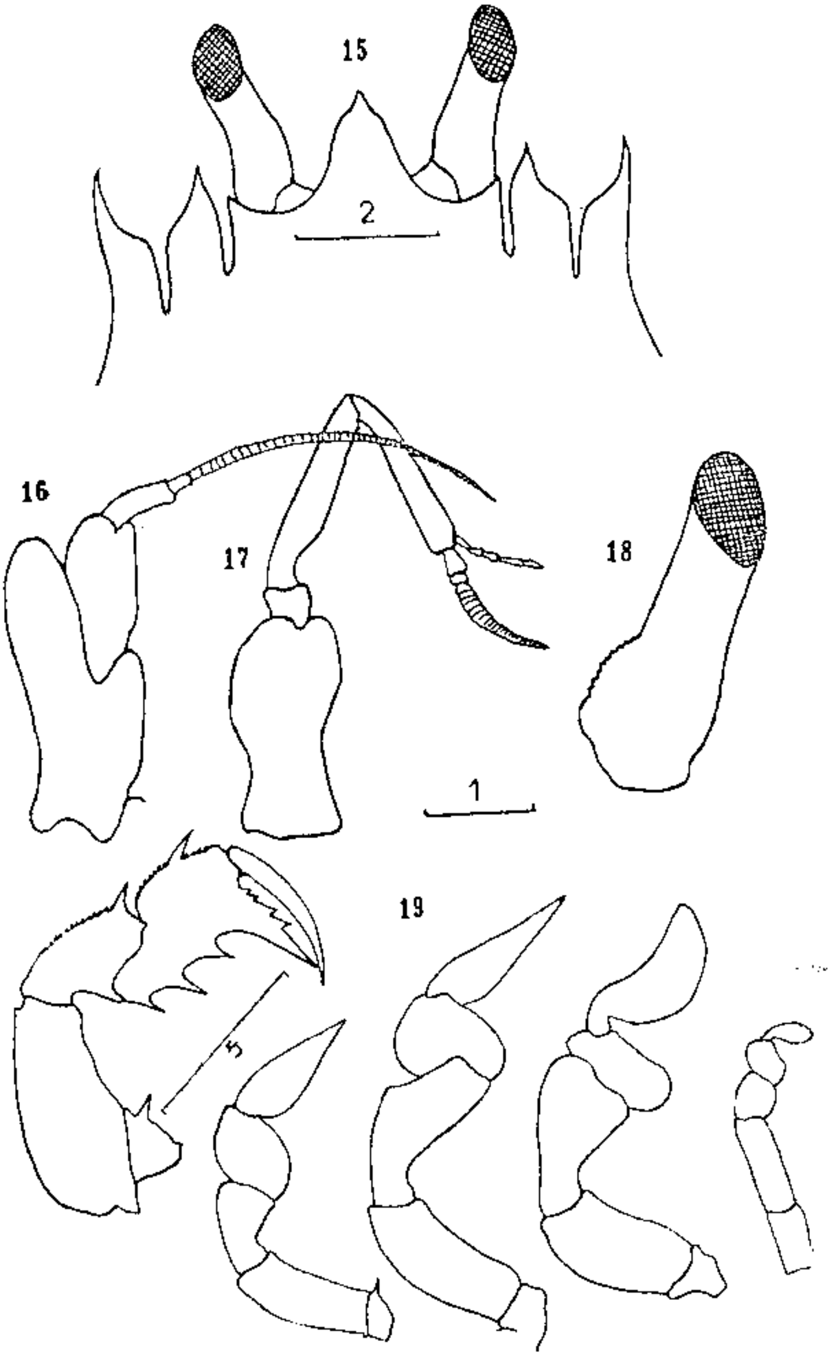
Genus NOTOSCELES Bourne, 1922

Notosceles BOURNE (1922) 73; WARD (1942) 47.

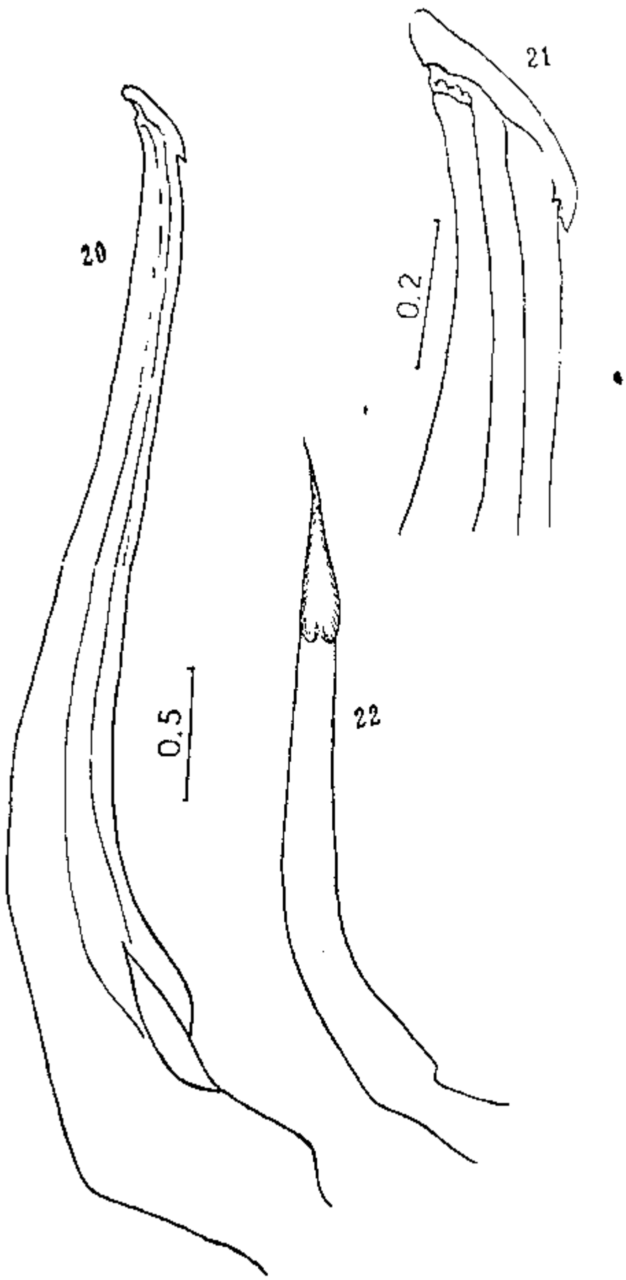
Remarks.—The different species under this genus are: *chimonis* Bourne; 1922, *serratifrons* Henderson, 1893, and *viaderi* Ward, 1942.

Bourne (1922) states that *Notosceles* differs from *Raninoides* in the following characteristics: (*1*) the proportion of the carapace, (*2*) the shape of the rostrum; (*3*) the lesser width of the fronto-orbital region; (*4*) the larger cornea of the eyes; (*5*) the relatively much greater width of the base of the abdomen; and (6) the proportion and shape of the sternal shield.

Chopra (1933), by comparing specimens of *Raninoides personatus, R. serratifrons,* and *R. hendersoni*, doubted the generic value of those aforementioned characters because *hendersoni* is an intermediate form which links *Raninoides* and *Nostosceles.* In *Notosceles* as shown by Bourne (1922, Plates 2 and 3), the sternal shield is much more narrowed posteriorly than in *Raninoides.* Chopra (1933) illustrated the sternal shield of these three species and he concluded that *R. hendersoni,* based on this character, is an intermediate form between *R. serratifrons* and possibly *N. chimonis* on the one hand, and *R. personatus* on the other. The characters noted in the specimens studied clearly show that *serratifrons* and *chimonis* are closer to each other than *personatus* and *hendersoni*. In like manner, the characters of *viaderi,* as shown in the illustration of Ward (1942, Pl. 4, fig. 6), place it closer to *chimonis* and *serratifrons.* The antero-lateral lobe of the first sternal plate immediately below the basis of the third maxilliped in *chimonis* is, however, narrow and the distal



FIGS. 15-19. *Raninoides hendersoni* (male, size 9 x 11): *15*, fronto-orbital border; *16*, antenna; *17*, antennula; *18*, eye peduncle; *19*, pereopods, 1-5.



FIGS. 15-22. *Raninoides hendersoni* (male, size 9 x 11): *20-21*, pleopod 1; *22*, pleopod 2.

end directed obliquely forward, while in all the other species of *Notosceles* and *Raninoides*, it is broader with the anterior margin convex and the distal end directed obliquely outward.

Regarding the other differentiating characters given by Bourne (1922) Nos. 1, 2, 3, 5, they do not seem to have generic significances. The eyes, however, in *Notosceles* are comparatively stouter and shorter than in *Raninoides*.

Bourne (1922) and Chopra (1933) disregarded several differences between the two genera. In the key we made mention of the lateral process of the sternal plate between pereopods 1 and 2, which is acute in *Raninoides* and obsolete or rounded in *Notosceles*. Also, while in the former genus a spine is present in the ischium of the cheliped, this is absent in the latter. While the male pleopods of *personatus* and *hendersoni* are very similar, they are different from that of *chimonis*, this being much closer to *serratifrons* as illustrated by Barnard (1950, fig. 75 g).

The shape of the dactyli of pereopods 2 to 4 seems to have generic significance as shown in the following Table 1:

	1	2	3	4	5
Dactylus of pereopod 2	A	A	C	B	C
Dactylus of pereopod 3	A	A	D	C	C
Dactylus of pereopod 4	B	C	C	D	C

"A" — Lanceolate leaflike dactylus with the asterior and posterior margins convex.

"B"—Chopper's bladelike appearance with the anterior margin straight, and the posterior convex.

"C" — Shallow sicklelike, the anterior margin somewhat concave and the posterior somewhat convex.

"D" — Deep sicklelike, the anterior margin deeply concave and the posterior strongly convex.

1,—*personatus*; 2, *hendersoni*; 3, *chimonis*; 4, *viaderi*; and 5, *serratifrons*.

Only in *personatus* is the size of pereopod 5 markedly smaller.

NOTOSCELES CHIMONIS Bourne, 1922. **Plate 3, figs. 4-6; Text figs. 23-27, 33.**

Notosceles chimonis Bourne (1922) 74, Pl. 4, figs. 2 & 3; Pl. 5, fig. 24; Pl. 6, figs. 40-43; Pl. 7, figs. 44-47 and 57.

Materials.—NMP 1305, male, size 16 x 11, 9 miles SW of Cape Melville, Balabac Island in 25 to 28 fathoms, by Pele Sulu Sea Expedition, 1964; NMS 1968. 1.25.25, female, size 33 x 16, "Jalanidhi" Cruise, 1963, Indonesia, Location, 4° 35' S, 120° 40' E (Flores Sea); Collected by Kasijan.

History and observations.—Bourne (1922) described the species from two males, the largest, size 20 x 13, collected in the Sulu Sea,

and presented to the Oxford University Museum in 1872, where probably the type is also maintained.

Comparative study of our illustrations shows that *chimonis* differs from *personatus* in the following aspects:

(*1*) The distinctive features of the fronto-orbital border; (*2*) the narrower frontal region beyond the antero-lateral teeth which is ornamented by small acute granules; (*3*) the broader basal segment of the antennular peduncle; (*4*) the much broader external distal process of segment 2 of the antenna; (*5*) the broader and shorter eye peduncles with shorter cornea; (6) the much narrower sternal shield; (*7*) the much shorter ischium of the third maxilliped when compared to the merus — 1.54 times in *chimonis* and 1.49 times in *personatus;* (*8*) the absence of spines on the merus of the cheliped; (*9*) differences in the features of the carpus, propodus and dactylus of pereopods 2 to 4; and (*10*) the larger pereopod 5.

It is probable that many of these characters have generic significances. However, additional studies on the other species are as yet to be made. The proportion of the length of the merus to that of the ischium of the third maxilliped, for example, seems to be of some value, although the shape of the merus in *Notosceles* (esp. *chimonis*) with an antero-lateral convexity seems to be more significant.

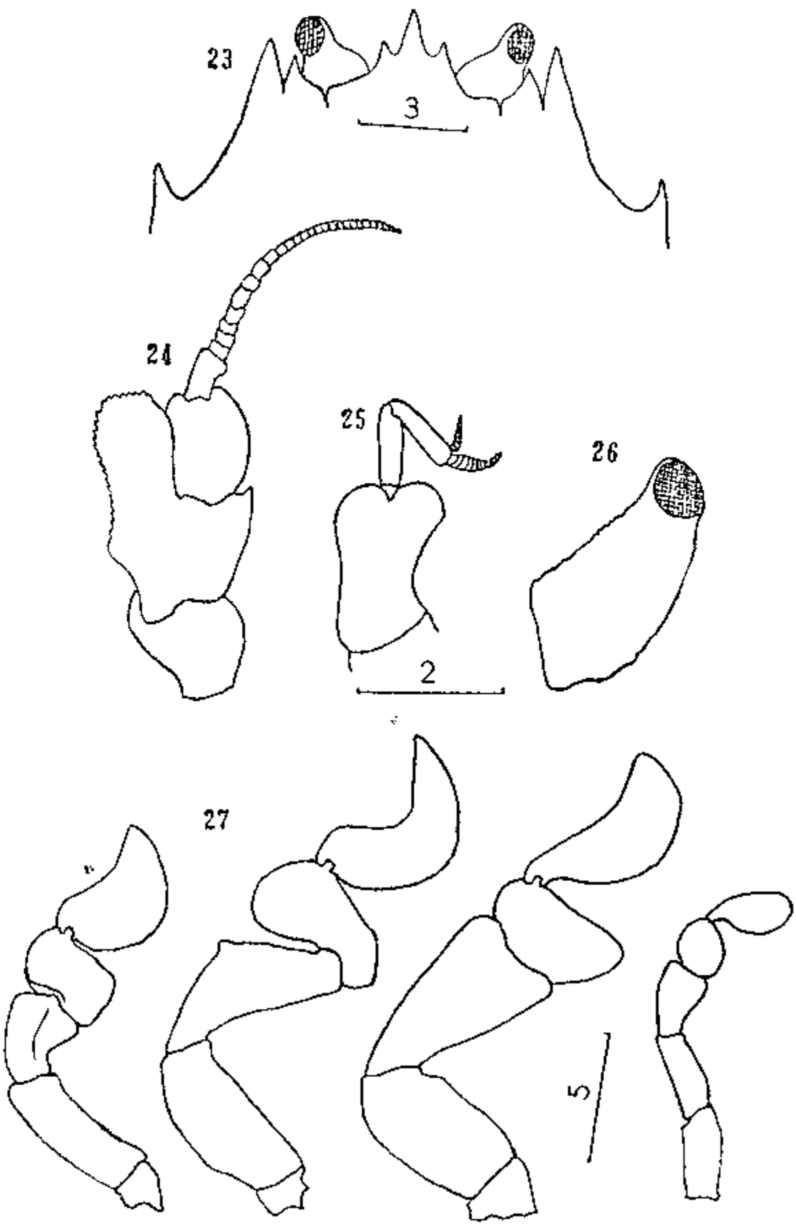
This new record extends the distribution of this species from Sulu Sea to Flores Sea.

NOTOSCELES SERRATIFRONS Henderson, 1888. **Plate 3, figs. 7-10; Text fig. 34.**

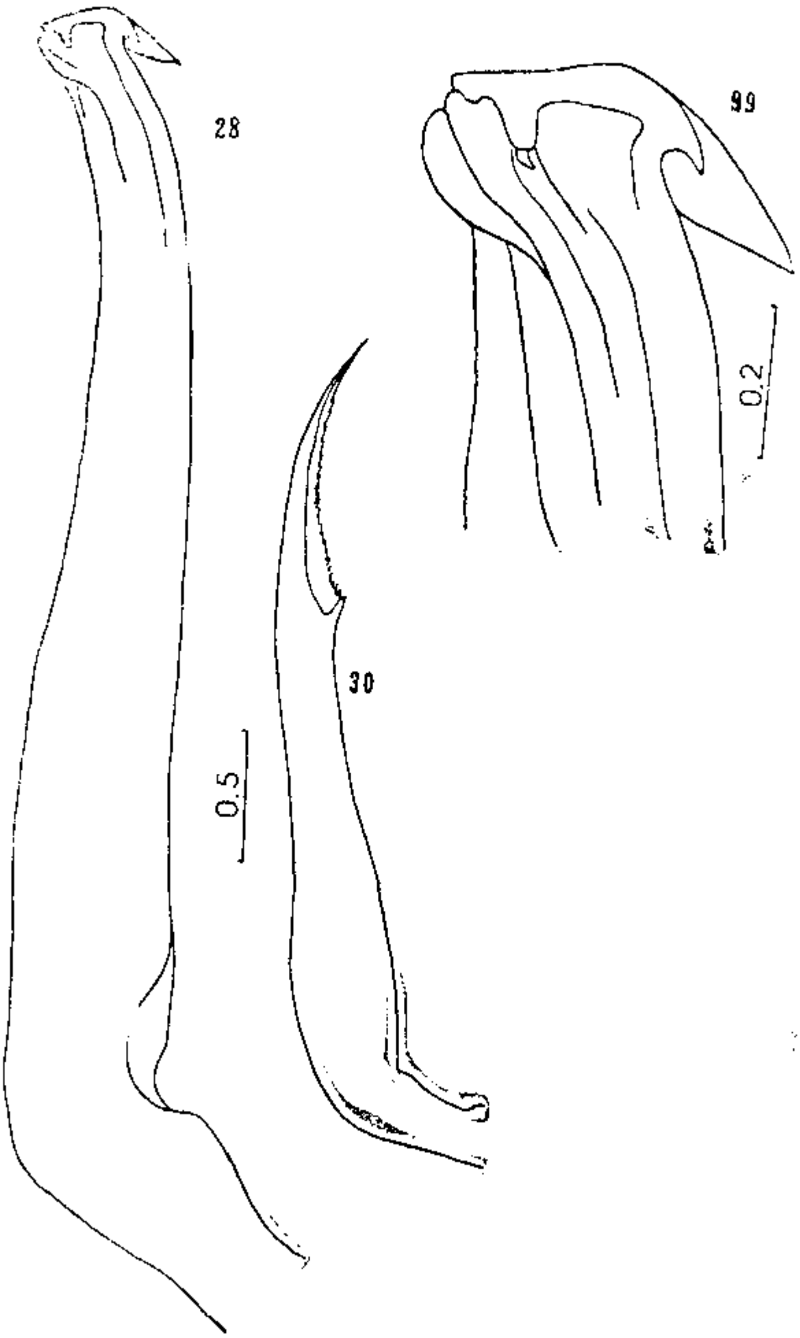
Raninoides serratifrons HENDERSON (1888) 403, figs. 10-12; ALCOCK (1896) 293; LAURE (1906) 367; STEBBING (1920) 250; CHOPRA (1933) 86, Pl. 3; figs. 3 & 3a, text fig. 1c; SAKAI (1936) 67, Pl. 14, fig. 2; SAKAI (1937) 166, Pl. 16, fig. 3, text fig. 37; SAKAI (1965) 2, Pl. 1, fig. 4; BARNARD (1950) 399, fig. 75e-g.

Material.—A female, size 20 x 11, Thai-Danish Expedition 1966, Station 1032-1, Jan. 20, 1966, West Coast of Thailand, Andaman Sea. Collected by Prof. Thornson.

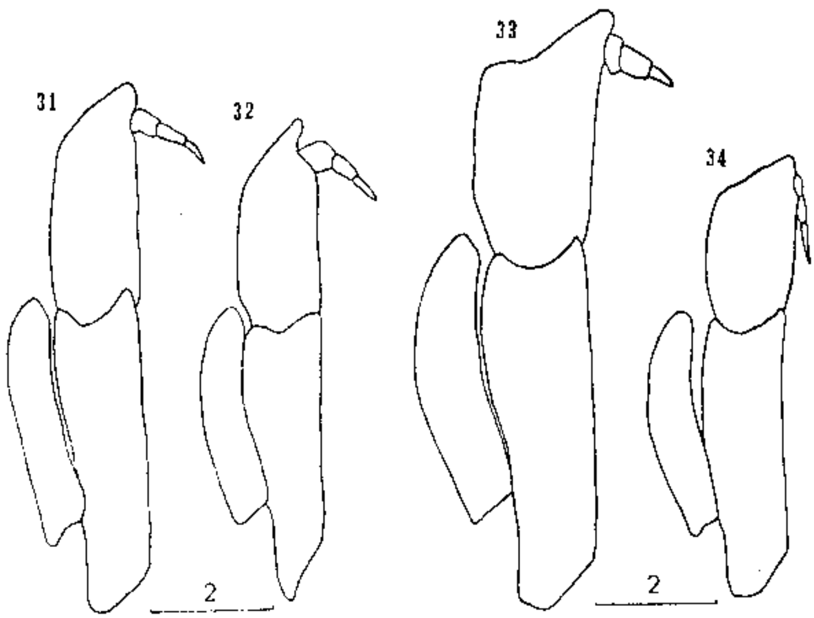
Observations.—This specimen was studied for purposes of comparison. Unfortunately it was female, and therefore, we have to rely on the illustration of a male by Barnard (1950, fig. 75), where the pleopod appears closer to that of *Notosceles chimonis* than to those of *R. personatus* and *R. hendersoni*. However, this present specimen is much more spinulous than those described and illustrated by authors. On the anterior part of the carapace not only the rostrum but also all the anterior teeth are spinulous, and on the



FIGS. 23-27. *Notosceles chimonis* (female size 33 x 16): *23*, fronto-orbital border; *24*, antenna; *25*, antennula; *26*, eye peduncles; *27*, pereopods 2-5.



FIGS. 28-30. *Notosceles chimonis* (male, size 16.5 x 11): *28-29*, pleopod 1; *30*, pleopod 2.



FIGS. 31-34. Third maxillipeds: *31, R. personatus; 32, R. hendersoni; 33, N. chimonis; 34, N. serratifrons.*

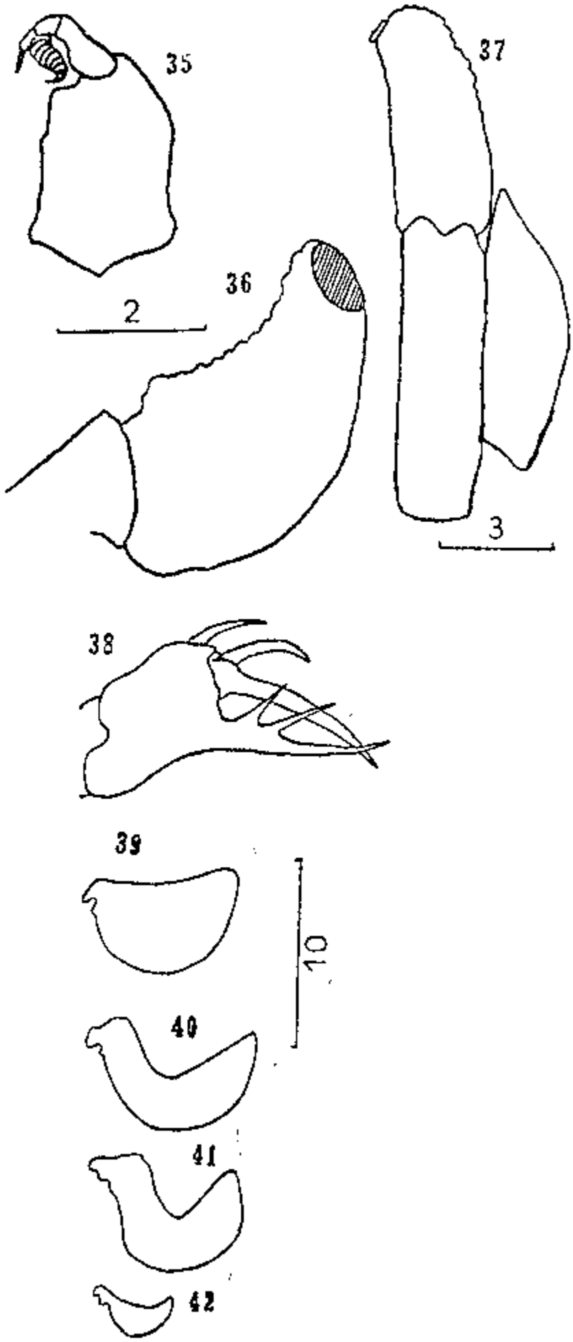
region between the extraorbital and lateral teeth, the spinules are much larger than usual. The acute granules on the outer face of the palms are also much larger and more acute; the most noticeable difference is the carpus which is ornamented with long acute spines, the two larger ones being the inner, which is developed as a large rounded lobe, and the other the outer subdistal. With the availability of additional materials, perhaps a new variety of *serratifrons* may be defined based on these differences.

Based on the present materials, the significance of the following differences between *Raninoides* and *Notosceles* have been confirmed: (*1*) the shorter eye peduncles in *Notosceles;* and (*2*) the truncate antero-lateral border of the third maxilliped in *Notosceles* instead of regularly convex form in *Raninoides.*

Genus CYRTORHINA Monod, 1956

Cyrtorhina, MONOD, 1956, 49.

In establishing *Cyrtorhina* for a species of the Atlantic African coast, Monod (1956) placed the genus as very close to *Ranina,* but is differentiated from the latter by the shape of the dactyli of pereopods 3 to 4; by the supraorbital and antero-lateral teeth (spines)



FIGS. 34-42. *Cyrtorhina balabacensis* (female, size 38 x 33): *35*, antennula; *36*, eye peduncles; *37*, third maxilliped; *38*, palm and fingers of cheliped; *39-42*, dactyli of pereopods 2, 3, 4, 5.

on each side of the rostrum; and by the palm and fingers of the cheliped. We consider *Cytorhina* closer to *Symethis*. The male pleopod of *C. granulosa* [Monod (1956), figs. 30 and 31] is close to that of *Raninoides*. In his description of this species, Monod (1956) 52 and figs. 21-23) made mention of a triarticulate eye peduncle with the segment 1 very short and only ventrally visible and the segment 2 triangular and elongate, a little shorter than the distal segment. With the exception of *Ranina*, the eye peduncles of all the specimens of Gymnopleura examined by us have the same structure, but the lengths of segments 2 and 3 are a little different in the other genera. It is only in *Ranina* where the three segments are nearly subequally long and bent one against the other as shown in Monod's illustration.

The name *Cyrtorhina granulosa* was originally proposed by A. Milne Edwards for a specimen without indication of locality and date, and maintained (dry) in the collection of the National Museum of Paris but was never published. Monod (1956) designated this specimen, size 33 x 29, as the holotype and two other male specimens as paratypes — one male, size 40 x 34 from off Accra, Gold Coast, is maintained in the British Museum, and the other, size 36 x 32, from the same locality, and maintained at the Unversity College, Gold Coast.

The species *balabacensis* from Sulu Sea differs from *granulosa* in: *(1)* the merus of the third maxilliped which is shorter than the ischium, and which, in *granulosa*, are subequal; *(2)* the presence of only 10 swollen segments in the flagellum of the antennae, while there are 20 such segments in *granulosa*, the size regularly decreasing toward the tip *(3)* the absence of the hepatic tooth which is present in *granulosa*; *(4)* the difference in ornamentation, with the posterior half of the carapace less granular and with larger mushroom-shaped tubercles; and *(5)* the general coloration which is grayish, but red wine in *granulosa*.

Concerning the other characters, *balabacensis* is so close to *granulosa* that further description might repeat partially the description of Monod (1956) of *granulosa*. Monod (1956) failed to mention the features of the sternal shield. In *balabacensis*, the second and third elements of the sternal shield are broad and convex in front but are narrowed posteriorly, and that the bases of the first and the second pereopods are approximately in the middle. These characters may be true for the genus.

CYRTORHINA BALACENSIS Serene, 1971. **Plate 4, figs. 1-3; Text figs. 35-42.**

Cyrtorhina balabacensis Serene, 1971

Materials.—NMP 1346, female with carapace 38 x 33; extra-

orbital breadth 11; breadth between posterior antero-lateral spines 29; largest breadth of carapace 33. Off Cape Melville, Balabac Strait, in 12 to 14 fathoms, Pele-Sulu Sea Expedition, 1964. This one and only specimen is designated as the holotype.

Description.—Carapace longer than broad, oval in shape and convex from both the antero-posterior and lateral axes; lateral borders (outlines) regularly convex. Extraorbital breadth far behind posterolateral spines, a little less than one third the widest part of carapace. Dorsal surface of carapace minutely granulate for most part, only strongly granular on anterior region extending a little behind line connecting lateral teeth. Here granules are flattened and regularly increasing in size toward frontal region where they are mushroom-shaped; similar but smaller and coalescent granules cover bases of extraorbital spines and rostrum. Similar ornamentation present on ventral side covering pterygostomian region and antennal peduncle. Triangular rostrum pointed, somewhat more prominent than extraorbital spines. Two intermediate teeth present on supraorbital border, the one closer to rostrum corresponds to inner supraorbital angle at junction between antennae and eye peduncle; outer and stronger tooth, close to extraorbital angle (tooth) with external margin very convex, and with tip distally bent inward. A ventral denticle present close to extraorbital tooth. Monod (1956) described the same features present in *C. granulosa*, such as, tridentate rostrum and extraorbital complex with one dorsal and one ventral denticle closely associated with main extraorbital tooth.

On the dorsal surface of carapace a transverse depression runs behind each extraorbital tooth which appears as constriction of carapace. Some few isolated round granules ornament the depression which is vaguely delimited although marked posterolaterally by a pair of strong conical tubercles situated inside, and nearly at level of first antero-lateral tooth, and marked medially by less prominent but compact patches of tubercles which all together look like a short and broad median carina. In front of this ornamentation, posterior part of rostrum appears as a deep and short median sulcus. Two antero-lateral teeth behind extraorbital tooth, the anterior being the larger. Monod (1956) counted 3 anterolateral teeth and one hepatic tooth dorsally visible between anterolateral teeth 1 and 2, in which 1 corresponds to the conical tubercle in *balabacensis* in this paper. This tubercle is situated inside the line connecting the anterolateral teeth to the extraorbital tooth as there is no indication of a hepatic tooth in this species.

As in *granulosa,* eye peduncle short and cornea small; antennulae, completely concealed under basal segment (1 + 2 + 3) of antenna, strong. First segment (4) of flagellum with same coarsely granulate feature similar to the basal segment into which latter segment it is closely inserted. Second segment nearly as long as broad, distally dilated; nine other segments all shorer, slightly increasing in breadth subdistally. Flagellum in natural condition strongly bent as in *granulosa,* total length less than length of basial segment, peduncle comparatively much larger than in *granulosa* due to larger size of swollen segments. Merus of third maxilliped, which is shorter than ischium, ornamented by mushroom-shaped tubercles. As in *granulosa* palp very short, entirely concealed into fossae of distal part. Chelipeds equal, nearly smooth; shiny merus arched, nearly as long as carpus and palm; palm a little longer than wide with one superodistal inner acute spine; fixed finger very slender and acute (acicular) with three spiniform teeth increasing in size toward tip. Movable finger (dactylus) also acicular or needlelike, distally crossing tip of fixed finger, with a strong acicular spine which has a length intermediate between the length of the dactylus itself and that of the distal spine of the palm. Pereopods 2 to 5 and abdomen resemble *granulosa.*

Color of specimen in alcohol, body grayish white, somewhat pinkish on anterior part of carapace; chelipeds distinctly pink, the long spines white with pink tips.

Subsection CORYSTOIDEA Dana, 1852

Family CORYSTIDAE Dana, 1852

Genus NAUTILOCORYSTES H. Milne Edwards, 1837

Nautilocorystes H. MILNE EDWARDS (1837) 149; ALCOCK (1899) 104; STEBBING (1910) 311; BARNARD (1950) 302.
Dicera DE HAAN (1841) 14; HELLER (1865) 70.

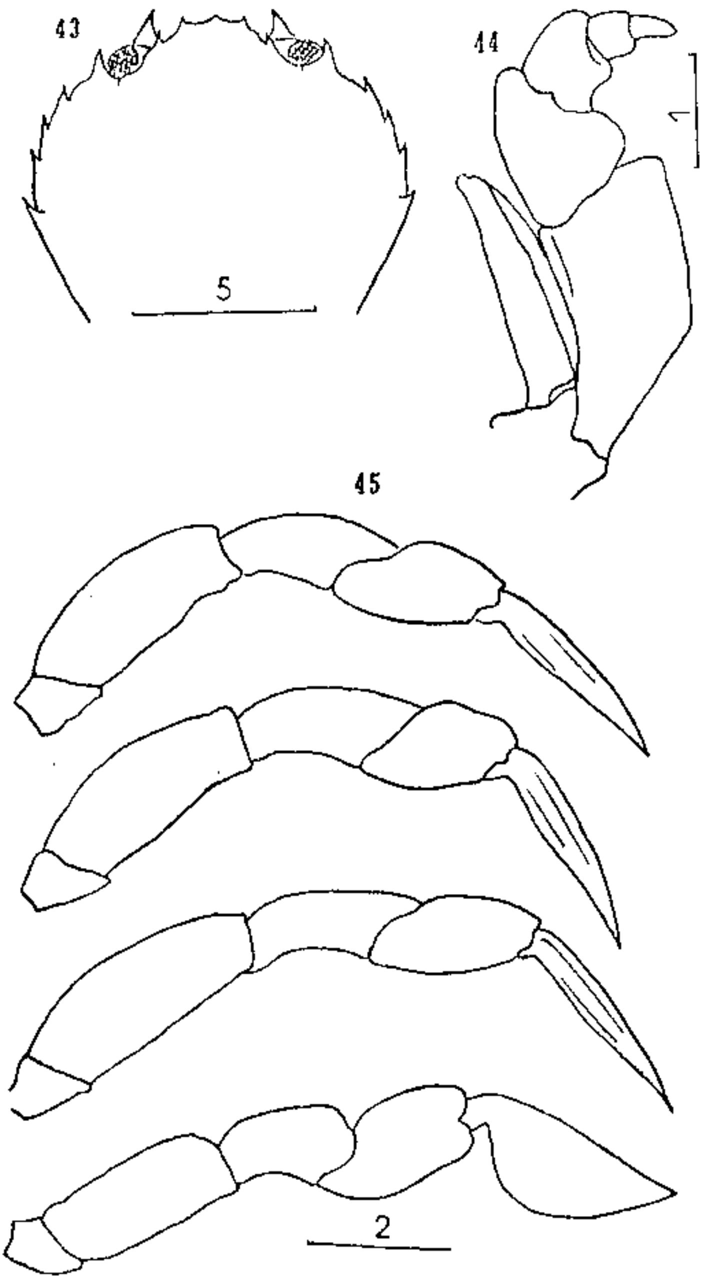
The genus includes two Indo-Pacific species; namely, *N. ocellata* Gray, 1831 and N. *investigatoris* Alcock, 1899 which are differentiated in the followng key:

i. Front entire, pointed; propodus of cheliped without spine on upper margin .... *N. ocellata*
   Front tridentate; propodus of cheliped with two spines on upper margin, one proximal, the other subdistal .... *N. investigatoris*

NAUTILOCORYSTES INVESTIGATORIS Alcock, 1899. Plate 4; figs. 9-10; Text figs. 43-45.

Nautilocorystes investigatoris Alcock (1899) 104.

Materials. NMP 933, female, size 10.5 x 10.5, and another ovigerous female, size 10 x 10, Lusong Cove, Bataan Province,



FIGS. 43-45. *Nautilocorystes investigatoris* (female, size 10 x 10): *43*, outline of anterior portion of carapace; *44*, third maxilliped; *45*, pereopods 2-5.

Remarks.—Alcock (1899) described the species based on two females, one with eggs, collected from Vizagapatan Coast in 15 to 17 fathoms, and the largest, 6.25 x 5.5. Our illustrations confirm the specific characters given by Alcock (1899). The dactylus of the cheliped is canaliculated, and has a very long tooth on the proximal region. On both the inner and outer borders of the carpus two very feeble spines are present. The geographical distribution of this species which was previously known only from the Indian Ocean is now extended to Philippine waters.

Subsection OXYSTOMATA H. Milne Edwards, 1834

Family LEUCOSIDAE Dana, 1852

Subfamily EBALINAE Stimpson, 1858

Genus OREOPHORUS (TLOS) A. Milne Edwards, 1937

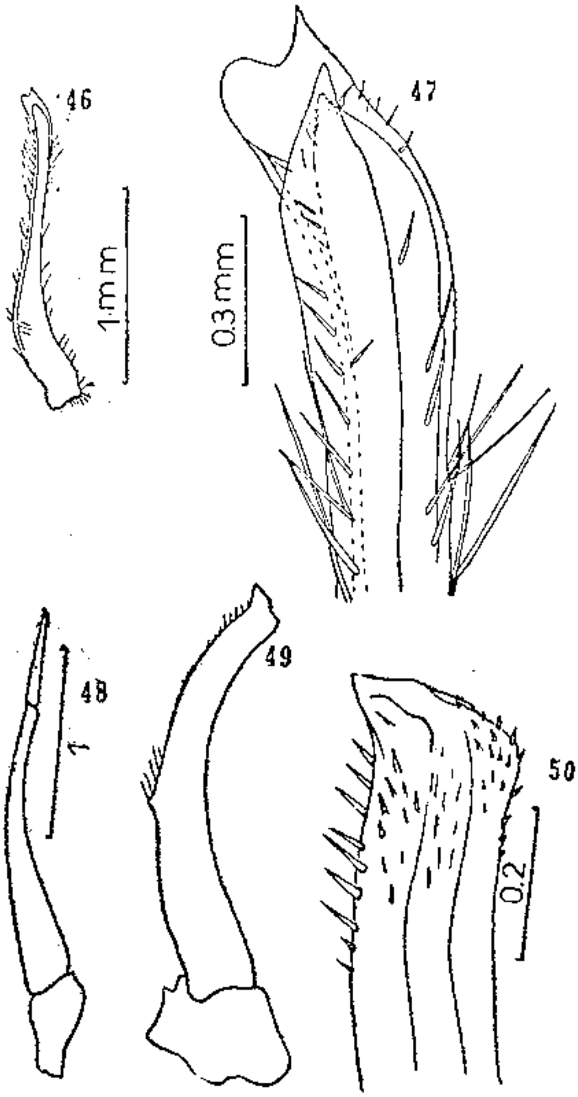
OREOPHORUS (TLOS) MURIGER Adams and White, 1848.
Plate 5, figs. 1-5; Text figs. 46-47.

Tlos muriger ADAMS and WHITE (1848) 58, Pl. 13, figs. 2 a-b; HASWELL (1882) 130; RATHBUN (1910) 306.
Oreophorus (Tlos) muriger IHLE (1918) 218.

Materials.—NMP 1182, female, size 9 x 13, Busuanga, Palawan; Copenhagen Museum, male, size 7.4 x 12.2 and a female, size 7 x 12, Gulf of Thailand, Rathbun 1910 determination.

History.—Adams and White (1848) described the species based on a female, size 10 x 14, collected off Borneo Island by HMS "Samarang." Haswell (1882) without indicating the number, size, and sex of the specimens recorded this species from Port Molle (Australia). These were collected by HMS "Alert" in 14 fathoms. Rathbun (1910) recorded three specimens from the Gulf of Thailand in shell bottom as follows: one male collected North of Knot Kut in 10 fathoms; one juvenile female from Koh Chuen in 30 fathoms; and one female from 6 miles East of Cap Liant in 9 fathoms. The specimens of Rathbun (1910) are maintained in the Zoological Museum of Copenhagen, from where Dr. A. Wolf kindly loaned to the senior author the male specimen which is illustrated in this paper together with the female of the National Museum of the Philippines. Ihle (1918) recorded one male from the west coast of Sumbawa.

Observations.—The two specimens examined agree with the brief description of the species given by Adams and White (1848), repeated by Haswell (1882), and amended by Ihle (1918) together with the only illustration given by Adams and White (1848). Based on the figure of Adams and White (1848, Pl. 13, fig. 2), the carapace is



FIGS. 46-47. Pleopod 1 of *Oreophorus* (*Tlos*) *muriger*, male, size 12.2 x 7.4.

FIGS. 48-50. Pleopods of *Parthenope* (*Rhinolambrus*) *sisimunensis*, male, size 9.5 x 10; *48*, pleopod 2; *49-50*, pleopod 1.

shown in the natural (horizontal) position, the front slightly higher than the intestinal prominence. In this paper the illustrations (Pl. 5, figs. A-B) show the considerable difference in outline when the front is lowered.

Status of the species.—Following Ihle (1918), *Tlos* is used at the subgeneric level as to include only three species; namely, *muriger* Adams and White, 1848, *petreus* A. Milne Edwards, 1874, and *havelocki* Laurie, 1906. The other two species, *Latus* Borradaile, 1903 and *angulatus* Rathbun, 1906 were assigned to the subgenus *Oreotlos* Ihle, 1918.

Key to the three species of the genus Oreophorus (Tlos)

1. Gastro-cardiac lateral prominences strong, high, truncate distally, and separated from the transverse oblique postcardiac ridge by a wide sulcus (groove). Posterior border and intestinal prominence of carapace project backwards beyond posterior branchial border. Four distinct marginal sutures (frontal, hepatical, antero-branchial and postero-branchial) present 2

   Gastro-cardiac lateral prominence similar to a round continuous bulge which is not separate from the transverse postcardiac ridge. Only two marginal sutures (frontal and hepatical) exist. Posterior border of carapace and intestinal prominence rounded, not reaching level of posterior branchial border .... *havelocki* Laurie, 1906

2 (1). Lateral margin of carapace strongly upturned; anterior part of carapace strongly concave; intestinal prominence posteriorly bilobate.
muriger Adams and White, 1848

   Lateral margin of carapace less upturned: outline of carapace more triangular, marginal suture deeper than in *muriger*.
petreus A. Milne Edwards, 1874

The separation of the species (*muriger*, and *petreus*, from *havelocki*) is not difficult. The species *havelocki* has been very accurately described and illustrated by Laurie (1906, 357, Pl. 1, fig. 2 and text-fig. 1) based on an adult male with a length of 5.75, collected in coral reefs in Ceylon and maintained in the British Museum. Sakai (1965) recorded with a beautiful color illustration, the second known specimen, a female, size 7.14 x 11.4 collected from Sagami Bay, Japan, at a depth of 35 meters.

In contrast, the separation of *muriger* from *petreus* seems to be based on insufficient differences. A. Milne Edwards (1874) 51, briefly described *petreus* from a female, size 7 x 10, from New Calendonia, which was dredged from a depth of 10 to 12 meters. He merely stated that *petreus* differs from *muriger* or the following aspects: (1) carapace more triangular; (2) antero-lateral border of carapace less upturned; (3) surface of carapace finely granular; and (4) marginal suture linear and deep. Mme. D. Guinot informed the senior author (personal

communication dated April 22, 1965) that while the type specimen of *petreus* is listed in an old catalog of the collection in the National Museum of Paris, she failed to locate it after a most diligent search and, therefore, must be considered lost. Only access to new materials would enable us to decide as to whether *petreus* could be considered a distinct species or merely a synonym of *muriger*. It is obvious that the illustration of *petreus* in A. Milne Edwards (1874) Pl. 3, fig. 1, differs from the illustration of *muriger* in Adams and White (1848), although it is difficult to determine just how accurate the figures are. The illustrations in this paper will readily show how the outlines of the carapace vary depending upon the position of the specimens when photographed, that is, as to the extent the frontal is lowered or raised. However, some detailed information on the outline of *petreus* may be deduced from the several views presented. In the female of the species, the posterior sinus separating the lateral border from the posterior border is more pronouncedly (deeper) shown, and the relief of the large intestine elevation (hump) less developed.

Subsection BRACHYGNATHA Borradaile, 1907

Superfamily OXYRHYNCHA Latreille, 1803

Family PARTHENOPIDAE Miers, 1879

Subfamily PARTHENOPIDAE Miers, 1879

Genus PARTHENOPE (RHINOLAMBRUS) A. Milne Edwards, 1879

PARTHENOPE (RHINOLAMBRUS) SISIMANENSIS sp. nov.

Plate 5, figs. 6-8; Text figs. 43-50.

Materials.—NMP 323, male, size 11 x 10, chelipeds 44, from Sisiman Bay, Luzon in 3 to 9 fathoms; NMS, 1969, 4.3.1., male, size 10 x 9.5.

Observations.—These subject specimens are characterized by the presence of two gastric spines, the anterior smaller than the posterior, one cardiac spine and a pair of transverse intestinal spines along the median longitudinal line of the carapace. On the branchial region are a pair of spines, the anterior somewhat larger, and in the Philippine specimen the posterior spine is much less developed than in the other specimens. All these spines are with notched, small, round tips. The postocular lobe is very prominent, although in the Philippine specimen, however, this is comparatively lesser developed than in others.

The presence of a pair of intestinal spines makes *sisimanensis* close to *turriger* but differs from all the other species of the *turriger*

group such as *cybelis, rudis* and *gracillimanus* all of which bear only one median intestinal spine. Considering the description of Alcock (1895) and the key of Flipse (1930) *sisimanensis* differs from *turriger* by the presence of two gastric spines and two branchial spines instead of only one of each in the latter. To differentiate *sisimanensis* from other species of *Parthenope*, the key of Flipse (1930) is modified as follows:

1. Carapace longer than wide or just as long as it is wide 2
   Carapace wider than long .... *P.* (*R.*) *petalophorus* Alcock, 1895
2. (1). Two intestinal spines present in transverse position 3
   Only one intestinal spine present 4
3. (2). One gastrict and one branchial spines present.
   P. (*R.*) *turrigr* White, 1857
   Two gastric and two branchial spines present.
   P. (*R.*) *sisimanensis* sp. nov.
4. (2). Two cardiac spines in longitudinal series 5
   Only one cardiac spine .... *P.* (*R.*) *rudis* Rathbun, 1916
5. (4). Two pairs of branchial spines ... . *P.* (*R*) *cybelis* Alcock, 1895
   Three pairs of branchial spines ..... *P.* (*R.*) *gracillimanus* Ward, 1942

In the separation of the species of this subgenus, the number of spines on the carapace and their distribution was employed following the authors. It is possible, however, that future revisions might show that those characters are variab'e, and that the presence of some spines might not be valid.

The genus *Rhinolambrus* A. Milne Edwards, 1878 with *Rhinolambrus contrarius* (Herbst, 1796) as the type species is characterized by the long and broad rostrum and the very distinct postocular constriction. No. male pleopod by any species of this subgenus have as yet been illustrated. Probably such information will improve the definition of this subgenus. In *sisimanensis*, the male pleopod 2 is nearly as long as pleopod 1 which bears spinules on the subacute chitinous apex.

In *sisimanensis*, the antennular segment 1 is a part of the orbital margin, this being inserted into the orbital hiatus with antennal segment X. In *naso* as illustrated by Flipse (1930) text-fig.14, the situation is entirely different in that the antennular segment I is isolated and does not invade the orbital margin and the orbital hiatus filled only by the antennal segment X.

In order to be able to distribute properly the different species into the several subgenera of *Parthenope*, it seems essential that all these subgenera be better defined.

Genus DALDORFIA Rathbun, 1904

DALDORFIA SPINOSISSIMA (A. Milne Edwards, 1862). Plate 5, figs. 9-10.

Cancer spinosus seu *Hippocarcinus hispidus Aldrovani*, SEBA (1758) Pl. 22, figs 2, 2a, 2b.
Parthenope spinosissima A. MILNE EDWARDS (1862) 8, pl. 18, figs. 1, 1b; A. MILNE EDWARDS and BOUVIER (1900) 120 and 121; ALCOCK (1893) 9; ALCOCK (1895) 280; FLIPSE (1930) 79.

Material.—NMP 1528, dry specimen, female, size 100 x 153 from Tres Reyes Island, Philippines.

History.—A. Milne Edwards (1862) described the species based on a female, size 10 x 16, from "Ile Bourbon." In his opinion, *Cancer spinosus* Seba, 1785 is identical to his new species rather than to *Cancer horridus* (Linnaeus) as claimed by several authors. Alcock (1895) recorded two specimens of the same species, one male and one female, without giving the size, from the Gulf of Bengal collected at a depth of 88 fathoms. Flipse (1930) only quoted the species in his list and key. Flipse (1931) recorded one female, size 83 x 133 from Ambon.

Observations.—The present specimen was donated by Col. Manuel Madrigal to the National Museum of the Philippines. The type specimen is probably located in the National Museum of Paris.

Family HYMENOSOMIDAE Stimpson, 1858

Genus ELAMENOPSIS A. Milne Edwards, 1873

ELAMENOPSIS LINEATUS A. Milne Edwards, 1873. Plate 5, fig. 11.

Elamenopsis lineatus A. MILNE EDWARDS (1873) 324, Pl. 18, fig. 4; TESCH (1918) 5 & 26, Pl. 1, fig. 5-5c.

Materials.—One female, size 2.3 x 3.3, Philippine Fisheries Research Station, Dagat-dagatan, Navotas, Rizal collection.

Remarks.—This species was described from a male specimen, size 3 x 4, from New Caledonia, collected on a sandy beach washed by brackish water. Tesch (1918) recorded the second specimen, a male from Great Sangir Island (between Menado and Mindanao), on a reef. The genus includes the only species *lineatus* which is characterized by: (*1*) the transverse oval carapace which is broader than long; (*2*) the ambulatory legs which are not longer than the breadth of the carapace; and (*3*) the rostrum which is short, bent ventrally with a transverse rim at its borders with the carapace.

Family XANTHIDAE Alcock, 1898

Subfamily XANTHINAE Ortmann, 1898

Genus GUINOTELLUS Serene, 1971

Guinotellus, Serene, 1971

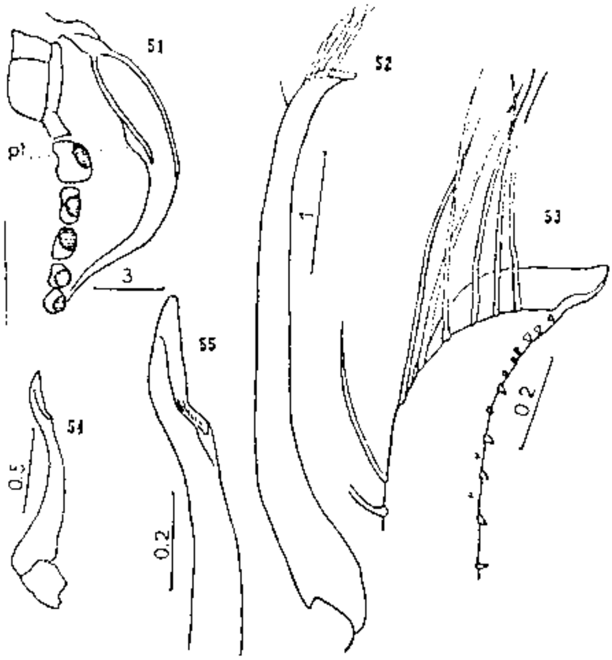
Definition.—Carapace somewhat wider than long. General outline of carapace oval, formed by: (*1*) salient and distally picked-up front; (*2*) distal part of supraorbital border; (*3*) regularly-convexed lateral border; and (4) slightly-convexed posterior border. Extra-orbital teeth absent. Dorsal surface strongly convex lengthwise and sidewise, devoid of any distinct indication of regions, and almost smooth and bare. Ventral surface granular on suborbital region, on third maxillipeds and on sternal shield. On each side, an elongate subhepatical cavity along lateral margin extending from orbit to opposite level of origin of cheliped and continued only very faintly towards posterior. Lateral border of front converging distally into a rounded angle; antennules folded obliquely forward and outward. Antennal peduncle completely close orbital hiatus, and flagellum occupies orbit. Third maxilliped and sternal shield occupy one third breadth of carapace. Length of merus of third maxillipeds less than half length of ischium. Segments 3, 4, and 5 in abdomen of males united, although demarcations clearly visible in the type specimen. Male pleopod 2 shorter than pleopod 1 like *Pilumnus* type. The whole body is covered (ornamented) with every short fine setae in the form of very thin cushion (tomentum). *Guinotellus melvillensis* Serene, 1971, which is also the type of this genus is without pereopods. The genus is named after Mme. Guinot, the distinguish carcinologist of the National Museum of Natural History of Paris, as an acknowledgment of her valuable work on the revision of the genera *Euxanthus* and *Hypocolpus* which guided us in the description of the genus.

Discussion.—The subhepatical cavity is a structure common only to *Hypocolpus* and *Guinotellus*. In these two genera the following are common features, namely, the complete closure of the orbital hiatus by the elongate basal segment of the antennal peduncle, distally reaching the orbit so that the flagellum projects into it (orbit), [Guinot Dumortier (1960) Pl. 1, figs. 5 and 6]; the convexity of the carapace which dorsally marks the supraanterior part of the orbit and continues by the lateral frontal boarder; and the close similarity of the third maxillipeds, sternal shield and male abdomen. However, *Guinotellus* differs from *Hypocolpus* in: (*1*) the shape, proportion and ornamentation of the carapace; (2) the shape of the front; (*3*) the difference in the disposition of the hepatical cavity; and (*4*) the type of male pleopod 1.

GUINOTELLUS MELVILLENSIS Serene, 1971. Plate 6; figs. 1-6; Text figs. 51-55.

Guinotellus melvillensis, Serene, 1971.

Materials.—NMP 1345, male size, 12 x 14, carapace only. Off Cape Melville, Balabac Strait in 13 to 42 fathoms. Pele-Sulu Sea Expedition, 1964. Holotype deposited in the Museum of Natural History in Paris.



FIGS. 51-55. *Guinotellus melvillensis* (male, size 12 x 14): *51*, subhepatic cavity (p.t. pterygostomian line); *52-53*, pleopod 1; *54-55*, pleopod 2.

Observations.—The following are complementary characters given in the definition of the genus. The carapace is 1.16 wider than long. On its dorsal surface which is not perfectly smooth, but ornamented by some small flattened granules, some feeble indications of the regions are evident towards the anterior part. The lateral margins, together with the orbital and frontal borders are covered with minute granules. The continuation of the lateral border under the orbits as the upper margin of the hepatic cavities is very clearly seen from the dorsal view. On each side, the hepatic cavity is 2.5 longer than wide. The outer lateral margin of said cavty is formed by the lateral margin of the carapace which distally bends inwards to constitute its anterior margin. The inner margin of the cavity is a salient smooth rim which stops nearly at the level of the anterior

part of the articulation of the coxa of the pereopod I. Although the cavity itself continues as a pseudocavity, its depth, length, and breadth diminishes progressveily toward the posteror border of the carapace. The outer margins of this pseudocavity are still the postero-lateral margins of the carapace, but the inner is produced by the prolongation of the pterygostomian sulcus. While the pseudocavity has no salient margins, it has the same shiny smoothness and noticeable depression on the floor of the cavity itself. Towards the anterior portion, the pterygostomian sulcus is joined closely to the inner and salient margin of the hepatic cavity whence it begins to diverge a little so that this is duplicated towards the inside by a second less defined pseudocavity. On the outer margin of the cavity, a small inflecion of the lateral margin of the carapace seems to indicate the posterior end of the true cavity and its opening outside. An hepatic cavity separated into two by a median salient rim exists in *Hypocolpus rugosus stenocoelus* Guinot, 1960 [Guinot Dumortier (1960) Pl. 2, fig. 15] and into three by two salient rims in *H. abotti* Rathbun, 1894 [*idem.* (1960) Pl. 2, fig. 11] and *H. punctatus* Miers, 1884 [*idem.* (1960) Pl. 2, fig. 16]. In these three cases, however, the pterygostomian sulcus do not play any rôle whatsoever in the formation of the structure. Except in *Hypocolpus perfectus* Guinot, 1960 [Guinot Dumorter (1960) Pl. 2, fig.] the pterygostomian sulcus in the different species of *Hypocolpus* is generally far from the inner margin of the hepatic cavity and the space between them is usually granular. These structure perhaps play some role in effecting water current circulation for respiratory purposes of the organism. In *Guinotellus* it is probable that such current passing posteriorly could pass through what we call the pseudocavity. The absence of the pereopods in our specimen of *Guinotellus* would not enable us to make any further speculations. In the males of the species, abdominal segments 1 and 2 are shortest; 3 a little longer; 4 much longer; and 5, 6, and 7 elongate. More specifically, segment 7 at the base is as wide as it is long, with concave lateral border; segment 5 also at the base is 1.46 wider than long; segment 4 again at the base is 2.3, segment 3 is 5 times wider than long. Segments 3, 4, and 5 do not appear to be articulated in spite of the visible lines of demarcation. Male pleopod 1 is characterized by the presence of a patch of 7 very long subdistal setae and is different from pleopod 1 of the *Hypocolpus* species.

Genus MEDAEUS Dana, 1851 s. str.

Medaus Dana (1851) 125.
Medaeus (pars) authors.

Medaeus GUINOT (1967) 363.

Under this genus Guinot (1967) includes, *senso stricto*, only the Indo-Pacific species, *ornatus* Dana, 1852 and *elegans* H. Milne Edwards, 1867. For the following species, she established the corresponding genera: for *haswelli* Miers, 1886, the genus *Miersella;* for *simplex* H. Milne Edwards, 1873, *planifrons* Sakai 1965, and *noelensis* Ward, 1934, the genus *Paramedaeus;* for *granulosus* (Haswell 1882), *neglectus* Balss, 1922 and *edwardsi* Guinot, 1967, the genus *Medaeops.* She agrees to the transfer of *nodosus* A. Milne Edwards, 1867 to the genus *Halimede* and considers that *rouxi* Balss, 1935 is under the subfamily Pilumninae although she did not give it a precise new position (either Pilumninae or Eumedoninae), and that *serratus* Sakai, 1965 does not belong to the *Medaeus* group of genera.

Guinot (1968, p. 708) confirmed the status of the genus *Macromedaeus* Ward, 1942 and placed the following species under it; *punctatus* Ward, 1942, *nudipes* A. Milne Edwards, 1867, *crassimanus* A. Milne Edwards, 1867, *distinguendus* De Haan, 1835, *voeltykowi* Lenz, 1905, *quinquedentatus* Krauss, 1843, and *demani* Odhner, 1925.

The brief definitions by Guinot (1967) of the genera *Medaeus s. str., Medaeops,* and *Paramedaeus* mentioned, among other characters, the well-developed epistome in *Medaeus;* the absence of an expanded antero-lateral angle in the merus of the third maxilliped in *Medaeops;* and the very large antennular fossae in *Paramedaeus.* The photographs in the present paper of the antennular epistomial region of one species of each of the three genera are complementary to the available information. The scuptural markings in the form of eroded cavities on the epistome on the anterior part of the buccal frame, and on the merus of the third maxilliped are much more distinct in *Paramedaeus* than in *Medaeops* and *Medaeus.* Based on this sculptural markings the species *noelensis belong to Paramedaeus.*

In spite of the revision of Guinot (1967 and 1968), the separation of the different genera of the *Medaeus* Group and the identification of the different species are still quite difficult. While the genera *Macromedaeus* and *Leptodius* are readily separable from the other closely related genera by the type of male pleopod, it is difficult to distinguish the genera *Medaeus, Medaeops,* and *Paramedaeus* from each other because their male pleolpods are approximately of the same type. This artificial key to the genera could be of some help.

1. Male pleopod 1 without long subdistal setae 2
   Male pleopod I with long subdisatl setae 3

2 (1.) Male pleopod 1 subacuminate with numerous large and long subdistal curved spines [*M. nudipes* in Forest and Guinot (1961) fig 47 for the type of male pleopod 1] .... *Macromedaeus*

Male pleopod 1 with a long distal rounded process ornamented on its margins by at least some mushroom-shaped denticulation; some few, usually short, subdistal spines present [*L. exaratus* in Guinot (1967 fig. 21 for type of male pleopod 1] .... *Leptodius*

3. (1). Lobulations on region 4M of carapace distinct; meri of ambulatory legs with spines on anterior margin; [*M. ornatus* in Guinot (1967) fig. 39 for type of male pleopod 1]. .... *Medaeus*

Lobulations on region 4M of carapace absent 4

4. (3). Meri of ambulatory legs shorter, and stouter 5

Meri of ambulatory legs relatively slim and elongated. [*M. tuberculidens* in Guinot (1967) fig. 36 for type of male pleopod 1] .... *Monodaeus*

5. (4). Male abdomen somewhat slim with triangular telson [*M. Simplex* in Guinot (1967) fig. 25]. Male pleopod 1 somewhat slim and distinctly bent [Guinot (1962) figs. 4a-4b] .... *Paramedaeus*

Male abdomen broader with telson shorter distally, rounded or almost semicircular [*M. granulosus* in Gordon (1931) fig. 19]. Male pleopod 1 stouter and less bent [*M. granulosus* in Guinot (1967) fig. 40]. *Medaeops*

Specimens of the following species are made of record in the present paper: *Medaeus elegans, Medaeops granulosus, Paramedaeus simplex, Paramedaeus planifrons, Paramedaeus noelensis,* and *Medaeus (non Medaeus) rouxi.*

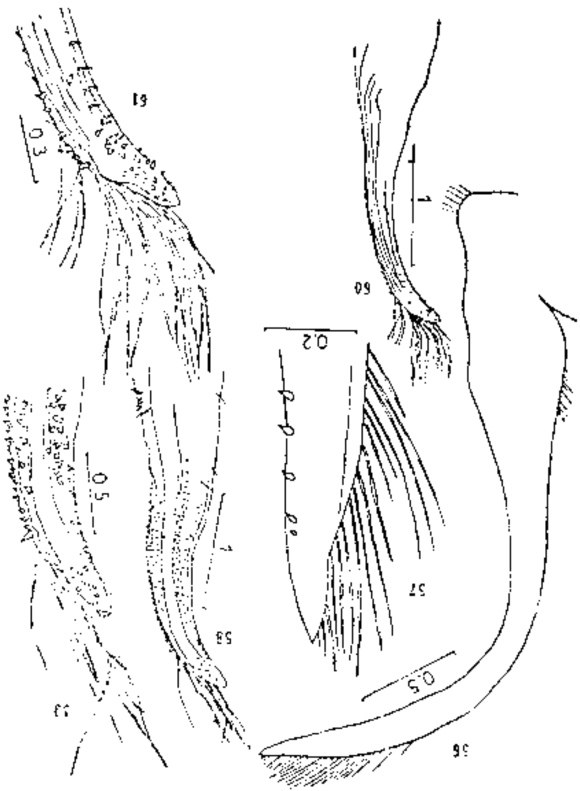
MEDAEUS ELEGANS A. Milne Edwards, 1867. Plate 6, figs. 7-10; Text figs. 56-57.

Medaeus elegans A. MILNE EDWARDS (1867) 270; (1873) 211, Pl. 8, fig. 1; BALSS (1938) 43 (not seen); HOLTHUIS (1953) 23; EDMONDSON (1925) 50; (1962) 236, figs. 4 & 6; GUINOT (1962) 18; (1967) 363, fig. 38.

Materials.—Male, size 11 x 14, and ovigerous female, size 9 x 14.5, Pele-Sulu Sea Expedition, 1964, collected from Pearl Bank in 10 fathoms; ION. 41962.

History.—A. Milne Edwards (1873) described *elegans* on a specimen, size 13 x 8. Holthuis (1953) quoted the species in a checklist. Edmonson (1925 and 1965) recorded the species from Hawaii where it is more common than *ornatus*. Guinot (1962) re-examined the holotype in the Paris Museum and in 1967 illustrated the male pleopod 1 of a specimen (size 13 x 21) collected by Th. Mortensen from Honolulu.

Observations.—Undoubtedly, our specimens are of the genus *Medaeus* because of the presence of 4M, and due to similarity of the pleopod 1 of our male specimen to that of *elegans* as illustrated by Guinot (1967). These two specimens illustrate very clearly di-



FIGS. 56-61. Pleopod 1 of different species: *56-57, Medaeus elegans*, size 14 x 11; 58-59, *Medaeops granulosus*, size 16.6 x 11; 60-61, *Paramedaeus simplex*, size 14 x 9.

morphism at least in the cheliped. In the male, for example, the right cheliped is very large (although the left was lost) with two very small nodules on its superior border, and the palm regularly granular without nodules or very distinct line of tubercles and covered extensively by the extension of the black color of the fingers.

In the female, the chelipeds are comparatively smaller and subequal; the palms ornamented by large nodules and lines of tubercles as follows: three longitudinal lines of tubercles on the outer face; a line of larger nodules on the superior border — one proximal (the largest), one distal and two submedian, which are not as large: and a line of three acute tubercles which are like large spines on the superior border. All the above characteristic features are close to those illustrated by Guinot (1927) fig. 26, for the species *ornatus*, a male specimen, size 8 x 11. The adult males of *elegans* and *ornatus* are not difficult to distinguish.

Basing on the illustrations of *ornatus* in Guinot (1967) figs. 26 and 39, and in full agreement on character 1 with Edmondson (1962), *elegans* differs from *ornatus* in the following features: (*1*) the lower but wider antero-lateral teeth in contrast to the longer and more acute ones in *ornatus;* (*2*) the more acuminate apex of the male pleopod 1; and (*3*) the less pronounced nodulation of the cheliped, at least, in the male specimens. As previously noted, this last character is not of much consequence in distinguishing female specimens. In the male, as illustrated in this paper (Pl.6J) and in agreement with Edmondson (1962), the black color of the finger extends to the greater portion of the palm. In the female, however, this black coloration is limited only to the fingers. In the illustration of the type specimen of *elegans* by A. Milne Edwards (1873) fig. 1a, the black marking does not extend to the palm, and therefore, the specimen is probably a female. Rathbun (1906) 849, mentioned in *ornatus* a similar extension of the black coloration on the palm of the two chelipeds. Similarly, all other authors who recorded specimens of *ornatus* [Dana (1852), Edmondson (1925 and 1962) and Guinot (1967)] confirm such extension of the black color from the fingers to the palm. And referring again to the illustrations of Rathbun (1906) 9, fig. 5, her identification of *ornatus* seems correct. Therefore, the extension of the black color to the palm is common to the two species. The male abdomen in *elegans* is relatively broad; the telson short and triangular with proximal border 1.25 times its length.

Genus MEDAEOPS Guinot, 1967

Medaeops Guinot (1967) 366.

Included under this genus by Guinot (1967) are the following species: *granulosus* Haswell, 1882, *neglectus* Balss, 1922, and *edwardsi* Guinot, 1967. She underscored the confusion existing between *granulosus* and *neglectus*. On the other hand, she recognized the close relationship between *Medaeops and Monodaeus.*

MEDAEOPS GRANULOSUS (Haswell, 1882) Plate 7, figs. 1-2; Text figs. 58-59.

Leptodius granulosus Haswell (1882) 61.
Xantho macgillivrayi Miers (1884) 211, Pl. 20 C.
Medaeus granulosus Odhner (1925) 61; Gordon (1931) 543, figs. 19 and 22A; Balss (1934) 507 (*pro parte*); Sakai (1936) 152, text fig. 74, Pl. 46, fig. 1; (1939) 459, Pl. 59, fig. 1, Pl. 90, fig. 5; (1965) 135, Pl. 69, fig. 2.
Lophopanopeus japonicus Rathbun (1898).

Lophoxanthus erosus PARISI (1916) 181, fig. 4; MENZIES (1948) 21, Pl. 4, fig. 33.

Medaeops granulosus GUINOT (1967) 366, figs. 21, 31, 41.

Non Medaeus granulosus BALSS (1934) 507 (*pro parte*); FOREST and GUINOT (1961) 51, fig. 45, Pl. 1, fig. 2; MONOD (1938) 127, fig. 17 A; BARNARD (1950) 219, fig. 41a, 42a, and 42b;? STEPHENSEN (1945) 148, fig. 27 A, B, = M. *neglectus*.

Materials.—R. S. 852, male, size 6 x 10.5; R. S. 453, two females, sizes 9.5 x 14.3 and 7.6 x 12, Quezon, Palawan, R. Serene coll. 1963 on shore at low tide; NMS. 1969. 4.15.1, male, size 11 x 16.6, Linderman Island, Australia, Ward coll. and det. 1934.

Observations.—The specimens R. S. 852 and 453 are now deposited in the National Museum of the Philippines where it is registered as No. NMP 1524. The larger male specimen from Australia was used as a comparative material. A series of specimens from several localities in the Malay Peninsula and Australia which are maintained in the National Museum of Singapore were examined. Guinot (1967) remarked that in several specimens of authors identified as *neglectus*, the pleopod 1 in males are very similar. She further stated that the comparatively much stouter ambulatory legs with the anterior border of the merus more crestate, especially in *granulosus* is a good distinguishing characteristic. By comparing the illustrations of the male abdomen of *granulosus* [Gordon (1931) fig. 19] with that of *neglectus* [Barnard (1950) fig. 42a under the name *granulosus* and corrected as *neglectus* by Guinot (1967)], it is evident that segment 6 is comparatively narrower and more elongate in *granulosus*, nearly as wide as it is long and even much narrower at the middle, while in *neglectus* it is broader than long. In our specimens it is as wide as it is long. Although the subfrontal region in these two species, [Guinot (1967) fig 21] is similar, the sculptural markings of the merus of the third maxilliped seem more distinct in *granulosus*, than in *neglectus*.

Genus PARAMEDAEUS Guinot, 1967

Paramedaeus GUINOT (1967) 373.

The three species included in this genus by Guinot (1967) could be distinguished from each other by means of the following key:

1. Frontal lobes remarkably salient with wide open median sinus; antero-lateral teeth 2, 3, and 4, acute, triangular and pointed outward; carapace narrower, its surface areolated and granular. Anterior border of meri of ambulatory legs carinated. Cheliped indistinctly dentate,

Carpus with small shallow facets, propodus sulcated with 4 teeth on its inner edge. Male pleopod as in Sakai (1965) text fig. 17a and b. Size 8.5 x 10 .... *planifrons* Sakai, 1963

Frontal lobes not remarkably salient with only a narrow median sinus ... 2

2 (1). Antero-lateral teeth 3, 4, and 5 acute, pointed outward and upward with large interspace and spinules on their margin: carapace ornamented with irregular transverse line of granules; anterior border of meri of ambulatory legs only slightly crested. Palm of cheliped not reticulate. A line of 4 to 5 granules on its upper margin. Male pleopod as in Guinot (1962) fig. 4. Size 9 x 4 ... *simplex* (A. Milne Edwards, 1873)

Antero-lateral teeth 3, 4, and 5 feeble, more or less coalescent, their interspace fitted by granules; carapace regularly covered with granules not transversely lined; anterior border of meri of ambulatory legs crested. Palm of cheliped reticulated. Male pleopod as in Forest and Guinot (1961) fig. 44. Size. 6 x 9. 5 .... *noelensis* (Ward, 1942)

PARAMEDAEUS SIMPLEX (A. Milne Edwards, 1873). Plate 7, figs. 3-4; Text figs. 60-61.

Medaeus simplex A. MILNE EDWARDS (1873) 3; DE MAN (1902) 643; RATHBUN (1906) 849; Pl. 9, fig. 10; (1911) 216; EDMONDSON (1925) 50: (1962) 235, fig. 5e; BALSS (1934) 508; WARD (1942) 54; GUINOT (1962) 18, figs. 4a-b.

Paramedaeus simplex GUINOT (1967) 373, fig. 25.

Material.—NMS 1965. 8.4.1, size 9 x 14, Batangas, Philippines, coll. P. Palanca 25/4/1963.

The present specimen which was originally maintained as a dry specimen in the collection of the Department of Zoology of the University of the Philippines, Quezon City, was identified as Xanthidae. In 1965, it was offered for further study to the senior author. It is now maintained in alcohol in the collection of the National Museum of Singapore.

History.—A. Milne Edwards (1873) described *simplex* based on a specimen from Madagascar, size 7 x 10, and another specimen from Upolu. De Man (1902) re-examined the two types which are maintained in the Museum of Hamburg, and at the same time, corrected the sizes as follows: 5.75 x 8.6 and 5.2 x 7.6 respectively. He also recorded another specimen from Ternate. Rathbun (1906) recorded two specimens (one male, size 13.4 x 20.2 and one female, size, 7 x 11.2 from Hawaii, and in (1911) a juvenile male, size 4.7 x 62. from Coetivy. Edmondson (1925 and 1965) recorded the species from Hawaii; Balss (1934) from the Red Sea and Madagascar; Ward (1942) from the Chagos; Guinot (1962) one male, size 7 x 10, from Hafun (Somalia); Guinot (1967) quoted for her illustration one male, size 13 x 19 from Mauritius, (Th. Mortensen Exped.).

Observations.—Undoubtedly the materials of the various authors are of the species *simplex* if the shape of the abdomen and pleopod 1 of the males are considered. However, some of the observations of the following authors seem inaccurate: It is surprising to note, e.g., that Edmondson (1952) described the carapace as "smooth." Again, as noted by de Man (1902), the branchial region is granular and the carapace has 4 antero-lateral teeth instead of only 3 as described by A. Milne Edwards (1873), and the dactylus of the cheliped canaliculated with the superior border lamellar.

With our specimen used in this study, the dorsal surface of the carapace, the pterygostomian and suborbital regions, the third maxilliped and the sternal shield are all strongly granular. The front is salient medially with a large notch and the anterior margin of each frontal lobe concave and oblique. The carapace is 1.57 times wider than long and cannot be considered as narrow as in *granulosus* where the carapace is only 1.45 times wider than its length. The line on the cheliped consisting of 4 to 5 large granules on the inner upper margin of the palm is well marked. The upper margin of the meral joint of the ambulatory legs is very slightly crested and smooth except the last pair which has 2 to 3 small granules present on the proximal portion. In males, the width at the base of the telson or the 6th abdominal segment, is 1.2 times its length.

PARAMEDAEUS PLANIFRONS Sakai, 1965.

Medaeus planifrons SAKAI (1965a) 101, figs. 2b, 3c, and d: (1965b) 137, Pl. 69, fig. 4.
Paramedaeus planifrons GUINOT (1967) 373.

Materials.—NMS. 1965. 7.7.2, female, size 6.25 x 9, from Cocos Keeling Islands, G.A. Gibson-Hill coll. 1941, identified by M.W.F. Tweedie as *Medaeus* sp. aff. *ornatus*.

History.—Sakai [(1965a) and (1965b)] described the species based on three males and two females collected from South Amadaiba, Japan, at a depth of 80 meters. The holotype is a male, size 8 x 10. Guinot (1967) recorded at the Copenhagen Museum a small female from the Banda Sea.

Observations.—This specimen at the National Museum of Singapore was re-examined by the senior author which he identified as *planifrons*.

PARAMEDAEUS NOELENSIS Ward, 1934. Plate 7, figs. 7-9.

Xantho distinguendos KLUNZINGER (1913) *nec* DE HAAN (1835) 203, Pl. 1, fig. 7.

Lophozozymus (*Lophoxanthus*) *bellus leucomanus* MIERS (1886) 115, Pl. 11, figs. 1a-1b.

Medaeus ranulosus BALSS (1934) [*nec* HASWELL (1882)] 507.

Medaeus noelensis WARD (1934) 17, Pl. 1, figs. 1-1a; FOREST and GUINOT (1961) 56, figs. 42-44a and b. Pl. 1, fig. 1; SAKAI (1965) 134, Pl. 69, fig. 1.

Paramedaeus noelensis GUINOT (1967) 373.

Material.—NMP 1521, male, size 5.5 x 8.5 Maluso Bay at 25 fathoms deep, Pele Sulu Expedition 1964.

History.—Ward (1934) described the species on a male specimen 6.5 from Christmas (I.O). Balss (1938) 61 considered *noelensis* as a synonym of *granulosus.* Forest and Guinot (1961) re-examined the type specimens in the British Museum, together with a male (no size) from Tahiti, one male 6 x 9.5 from Upolu, two males sizes, 5.8 x 9 and 4 x 6, from Mauritius in the Museum of Paris and two specimens from Samoa in the Munich Museum. Sakai (1965) recorded two males and two females from Japan. Guinot (1967) with reservation, included the species in *Paramedaeus.*

Observations.—The shape of the carapace of the specimens used in this study are different in that the postero-lateral border is concave instead of being straight. The breadth is 1.41 its length instead of 1.47, the proportion in the specimen of Forest and Guinot (1961). In comparison with the illustrations of authors, the front in our specimen is more salient, more pointed medially with the sinus more open. The differences simply indicate the existence of variations in the species *noelensis.*

The species *noelensis* differs from the two other species of the genus by the singular features of the antero-lateral teeth 3, 4, and 5 being much less salient, and by its smaller size and lesser number, not exceeding ten. Regarding the reserved opinion of Guinot (1967) to include the species under *Paramedaeus,* we observed that in the following features such as the frontal border, in our specimen at least; the subhepatic location of the antero-lateral teeth 1, 2; the male abdomen and male pleopod; the larger antennular fossae; the absence of 4M; and the slightly unequal male cheliped, all agree with the generic characters.

The anterior margins of the meri of the ambulatory legs in *noelensis* are more crested than those in *simplex* but lesser than those in *planifrons.* As was previously mentioned, the deep sculptural markings of the epistome, the anterior buccal frame and the merus of the third maxilliped in *noelensis* which are similar to those in *simplex* confirm that they are congeneric.

? MADAEUS ROUXI Balss, 1935. **Plate 7, fig. 10.**

Medaeus rouxi BALSS (1935) 45, Pl. 2, figs. 1 - 2.

Material.—NMS 1965 7.7.1, female with eggs, size 5.5 x 8; labelled "Siglap, Singapore; July, 1934—*Pilumnopeus* sp."

History.—Balss (1935) described *M. rouxi* on one male (type) 5 x 6, collected from Pamban, Gulf of Manaar, and deposited in the Basel Museum, one female collected from Krusadai Island, Gulf of Madras and deposited in the Madras Museum. He considers its systematic position doubtful, the species being closer to *Halimede* than to *Medaeus.*

Observations.—The present specimen is well characterized by the "flat rounded efflorescences projecting from the hepatic region (one on either side) as lobe-shaped structures" and similar "broad, rounded, granular, lobular, efflorescence" on carpus and on upper margin of propodus of the chelipeds. Regarding its aberrant position as *Medaeus,* Balss (1935) wrote: "In the lobular projections on the chelipeds and the hepatic regions this species comes very close to the genus *Halimede* (e.g. *H. tyche* of Herbst) but is distinguished by the oblique front (which in *Halimede* is transversely shortened), by its not greatly elongated and narrow abdomen of the male, which is characteristic of the genus *Halimede;* in our form, on the other hand, it is the usual *Xanthid* shape." Chopra (1935) comparing specimens of *H. tyche* with the female of *M. rouxi* deposited in the Madras Museum, also considers the forms close to, but different from each other by stating that, in addition to the differences noted by Balss, the chelipeds differ in shape and size in the two species. By comparing our specimen of *M. rouxi* with the specimens of *H. tyche,* the view of Chopra that *M. rouxi* does not fit in *Halimede* is confirmed. *M. rouxi* is closer to Pilumninae than to *Xanthinae.* In a hand-written label by M.W.F. Tweedie the present specimen was placed under *Pilumnopeus* to which it does not fit. At first glance it seemed close *to Pilumnus barbatus,* considering the existence of similar feature in the two species. Guinot (1967) 374, suggested that it be placed under *Parapilumnus* or in a genus close to it. The creation of a new genus seems in order, although it is necessary that a male specimen be first examined in order to provide some more valuable data for its definition and placement.

Genus CALMANIA Laurie, 1906

Calmania LAURIE (1906) 406; BALSS (1922) 137, GORDON (1934) fig. 32d; SAKAI (1935) 81; (1939) 547; (1965) 162.

Calmania Laurie, 1906 was originally established based on *C. prima* Laurie, 1906 as the type species. Sakai (1939) added the species *simodaensis,* and following the suggestion of Balss (1933) 44, he included *Litocheira sculptimana* Tesch, 1918 in this genus.

Using the characteristic features of the carapace as in the key of Sakai (1939) 512, the genus *Balmania* could be differentiated from the *Ralumia* as follows: (*1*) carapace of *Calmania* wider than long which, in *Ralumia,* is longer than wide; (2) presence of a transverse row of hairs just above the free edge of the frontal lobe instead of being on the free edge itself; and (*3*) antero-lateral borders which are without crest and are marked by three obtuse tubercles instead of the crested form in *Dalumia* with very indistinct tubercles.

The carapace of *C. prima* as originally described by Laurie (1906) had "its length and breadth equal" (cl: cb = 0.93) for a specimen with a length of 7. Although Sakai (1939) recorded several specimens, he mentioned the size of only one, 5 x 9.5. *C. simodaensis* is known only by the male holotype with a carapace length of 5.3 and breadth of 6 (cl : cb = 9.88). *C. sculptimana* was described based on 12 males and 6 females, the larger male was with cl 3.9, cb 4.4 (cl : cb = 0.88). *Ralumia dahli* was described based on a single female with cl 6, cb 7.2 (cl : cb = 0.83). *R. balssi* was described on a female holotype, size 7 x 7. The foregoing data clearly show that character 1 in the key of Sakai (1939) has no generic value. Because all the species in the two genera have their carapace wider than long or at least as long as broad, neither do characters 2 and 3 seem to have any value for use in the separation of the two genera.

The apexes of the male pleopods of *Calmania prima* [Sakai (1935) fig. 14], *Calmania simodaensis* [Sakai (1939) text-fig. 61], and *Ralumia* balssi [Takeda and Miyake (1968) figs. 4a and 4b] are only very slightly different from each other. The third maxillipeds of *C. prima.* according to the illustrations of Laurie (1906) Pl. 1, fig. 10, completely close the buccal cavity with the merus much broader than long, and so are also the merus of *C. sculptimana* [Tesch (1918) Pl. 8, fig. 2] and the present specimen *C. simodaensis.* On the contrary, the merus of the third maxilliped in *Ramulia dahli* is nearly as long as it is wide with gap existing between the two maxillipeds. In *R. balssi,* Sakai (1935) 79, only stated that the antero-lateral angle of the third maxilliped is expanded and the buccal cavity not as completely closed as in *C. prima.* In a female specimen of *R. balssi,* size 5 x 6 (Naga Report, in press) which was examined by the senior author,

the third maxilliped is similar to the present specimen of *simodaensis*. The telson of this female specimen of *R. balssi* is rounded and a little broader than the sixth abdominal segment as was illustrated by Tesch (1918) Pl. 8, fig. 2, for *sculptimana* and in our male specimen of *simodaensis*.

In spite of the fact that the front of *balssi* is less salient and more bent below with a transverse row of setae above its free edge, our opinion is that this species belongs to *Ralumia*. Further examination of *Ralumia dahli* is necessary in order to decide as to whether it could be included under *Calmania* because the only characters that might justify the generic separation are the narrow third maxillipeds with a wide gap between them, and the wider carapace.

For convenience, the following key is made to include all the species of the two genera:

1. Merus of third maxilliped nearly as long as broad, the antero-lateral angle not expanded; a wide gap between third maxillipeds. Carapace clearly much broader than long, 0.83 times, with frontal lobe less salient and bent below; the median sinus indistinct with a transverse line of long setae above free frontal edge. Three antero-lateral blunt tubercles and indications of 2 to 3 granules at the tip. Cheliped with small granules, some irregularly lined on external face of palm. Male pleopod unknown .... *Ralumia dahli*

   Merus of third maxilliped distinctly broader than long, the antero-lateral angle expanded; third maxillipeds completely closing buccal cavity without median gap. Carapace only a little broader than long. Genus *Calmania*, 2

2 (1). A transverse line of long setae on frontal edge 3

   A transverse line of long setae above frontal edge. Frontal lobes less salient, bent below; the median sinus indistinct. Carapace as long as broad with three blunt antero-lateral tubercles. Chelipeds with five lines of less numerous large granules on external face of palm. A small grap (?) between third maxillipeds. Male pleopod 1 as in Takeda and Miyake (1968) figs. 4a and 4b .... *C. balssi*

3 (2). Carapace not much broader than long 0.93 times, with frontal lobes prominent and median sinus somewhat deep; lateral border somewhat convex almost cristate with three small indistinct antero-lateral teeth. Chelipeds with two lamellate prominences on upper border, the dactylus strongly deviating inwards. Male abdomen with telson not broader than segment 6; male pleopod 1 as in Sakai (1935) fig. 14. *C. prima*

   Carapace comparatively broader; frontal lobes somewhat less salient. Dactylus of cheliped less deviating inwards. Male abdomen rounded telson, broader than segment 6 4

   inwards. Male abdomen rounded telson, broader than segment 6 4

4 (3). Carapace 0.88 times as long as broad; 3 antero-lateral teeth, the posterior very small but sharply angular. Chelipeds with external face thickly

granular, the granules organized in five longitudinal rows; upper border cristate. Male pleopod 1 as in Sakai (1939) text-fig 61. *C. simodaensis*

Carapace 0.88 times as long as broad; two antero-lateral teeth; no distinct supraorbital groove. External face of palm of cheliped with two longitudinal lines of granules, upper border also granular. Male pleopod unknown .... *C. sculptimana*

Several characters employed in the foregoing key need further re-examination, e.g. the presence of 2 to 3 granules at the tip of the antero-lateral teeth in the diagnosis of *dahli* which the senior author observed as present in his specimen of *balssi.*

Situation of the genus.—Laurie (1906) place *Calmania* under the family Xanthidae. Balss (1922) suggested that it be placed under the subfamily Eumedoninae of the family Parthenopidae and with a position close to the genus *Gonatonotus* because of the oblique direction (45 degrees) of the antennules in relation to the longitudinal axis of the carapace, the elongate rostrum, and the shortness of the buccal parts. Gordon (1934) and Balss (1957) are of the same opinion as Balss (1922). Similarly with Flipse (1930) and Sakai (1939), we maintain the genus under Xanthidae. It must also be noted that *Calmania* is very close, if not synonymous (?) to *Ralumia* which Balss (1957) classified under the subfamily Pilumninae of the family Xanthidae.

CALMANIA SIMODAENSIS Sakai, 1939. **Plate 8, figs. 1-4; Text figs. 62-63.**

Calmania simodaensis SAKAI (1939) 549, Text fig. 61 a-b.

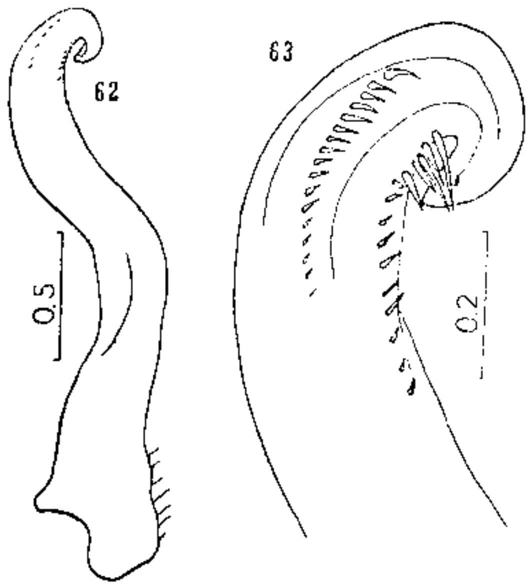
Material.—NMP 556, male, size 7 x 8, Sisiman Bay, Luzon in 3 to 9 fathoms.

Observations.—The species is known only by the holotype, male, size 5.3 x 6, collected on a tide pool in the shore near Simoda, Japan. In the present specimen the antero-lateral teeth are less distinct than in the illustration of Sakai (1939) fig. 61, and which could hardly be considered as "denticulated." The palm of the cheliped is almost identical to that *R. balssi* as illustrated by Sakai (1939) fig. 62b, although the fixed finger is more inclined downward in relation to the inferior border of the palm. The antennular region is identical with that of *C. prima* [Gordon (1934) fig. 32d]. The male pleopod 1 is similar to that illustrated by Sakai (1939) but the much larger magnification of the present illustrations show more details.

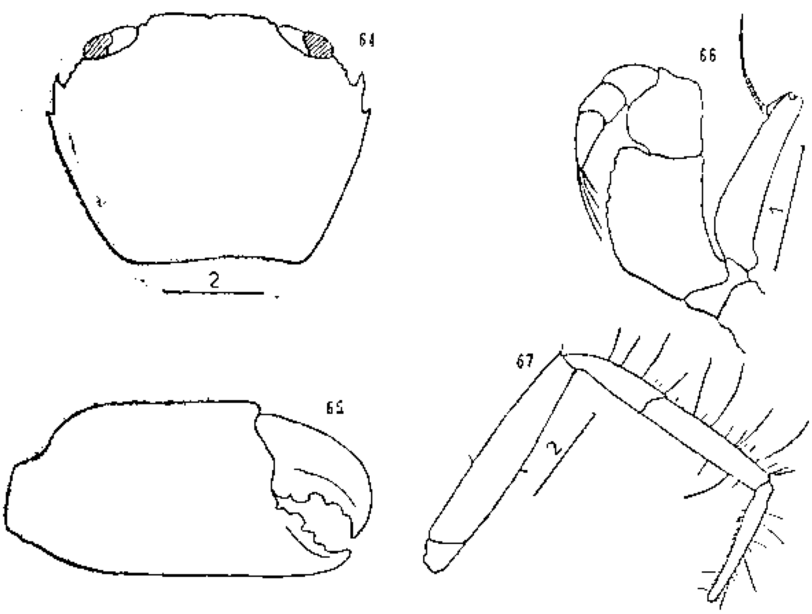
Genus PELEIANUS Serene, 1971

Peleianus Serene, 1971.

Description.—Carapace convex from side to side, smooth, bare, without indication of regions. Two small spinelike teeth on antero-



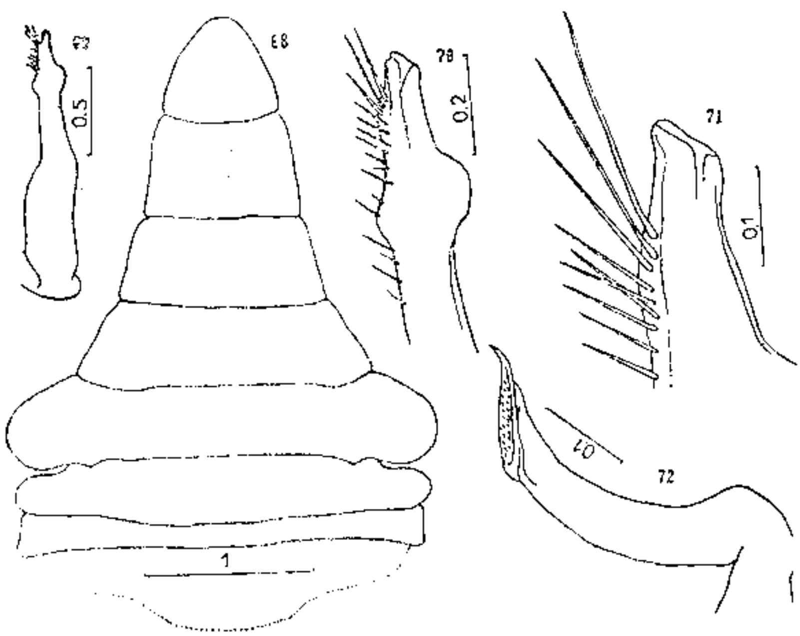
FIGS. 62-63. Pleopod 1 of *Calmania simodaensis*, size 7 x 8.



FIGS. 64-67. *Paleianus suluensis* (male, size 5 x 6.5): *64*, outline of carapace; *65*, palm of right cheliped; *66*, third maxilliped; *67*, pereopod 4.

lateral border, and extraorbital angle not marked. Postero-lateral border much longer than antero-lateral, slightly convergent posteriorly. Front nearly straight with only a small median sinus. Antennulae transverse. Male cheliped large with merus extending far beyond lateral border of carapace. Third maxilliped a little elongated with merus shorter than ischium and not much broader than long. Pereopods 2 to 5 very narrow and long with some very long, fine setae, pereopod 4 longest. Male pleopod 2 shorter than pereopod 1, similar to the *Pilumnus* type. The type species is *Peleianus suluensis* Serene, 1971.

Situation.—With reservations, the new genus is placed under the subfamily Pilumninae of the family Xanthidae where it is considered closed to the genus *Glabropilumnus.* It differs from the latter mainly by the type of male pleopod, and which as far as we know, is also different from all the other genera of Pilumininae. *Peleianus suluensis,* the type species, differs from all the other species presently included in *Glabropilumnus* in the following: *(1)* the distribution of the spines and granules on the antero-lateral margin; (2) the shape



FIGS. 68-72. *Paleianus suluensis* (male, size 5 x 6.5): *68*, abdomen; *69-71*, pleopod 1; *72*, pleopod 2.

of the cheliped; (*3*) the lengths and widths of the ambulatory legs; and (*4*) the shape of male pleopod 1. Basing on the ambulatory legs, *P. suluensis* is close to *Glabropilumnus laevis* Dana, 1852, and to which further comments will be made in the succeeding discussion. According to our studies, *Peleianus* differs from *Glabropilumnus* by the shape of the third maxilliped. In the former genus this is compartively much narrower and elongate, with the merus nearly as long as broad, while it is broader than long in *Glabropilumnus*. Also, the abdomen in male of *Peleianus* is comparatively broader than in *Glabropilumnus*.

PELEIANUS SULUENSIS, Serene, 1971. Plate 8, figs. 5-6; Text figs. 64-67.

Peleianus suluensis, Serene, 1971

Material.—NMP. A male size 5 x 6.5 Sulu Sea expedition 1964. Type specimen deposited in the National Museum of Natural History, Paris.

Description.—Carapace 1.3 times wider than long, its shiny, glabrous, and perfectly smooth dorsal surface convex sidewise and lengthwise, although to a much lesser degree in the latter. Front less than half (0.42) the greatest width of carapace with a straight anterior border, an indication of a small median sulcus, and a small antennal notch at its demarcation with the orbital border. Infraorbital angle rounded and suborbital margin denticulated. Basal segment of antennae relatively short with flagellum standing in orbital hiatus. Extraorbital angle not prominent. Antero-lateral border armed with a line of two small granules between orbital border and first and largest lateral teeth; distance between tips of anterior and posterior teeth equal to that between tip of anterior teeth and orbital border. The two teeth are acutely pointed resembling a spine obliquely directed forward. Postero-lateral border twice as long as antero-lateral.

Right cheliped very strong with anterior border of merus having fine acutely-pointed granules; carpus smooth, convex, and armed at inner angle with a short tooth; propodus nearly as long as breadth of carapace; palm smooth and glabrous; dactylus strongly convex, finely granular on distal part of superior margin; two fingers without gap between cutting edges, the latter armed with some large teeth.

Ambulatory legs slender and slightly hairy. In type specimen, dactylus of pereopod 4 without unguis on two sides perhaps by accident, which in other pereopods are acute. In pereopod 4, merus 4.5 times longer than broad; total length of carpus plus propodus

equal to total length of ischium plus merus; dactylus as long as propodus. Male abdomen broad, breadth at base a little longer than telson; segment six, 1.55 times wider than long at base; segment five, 2.33 times; segment four, 3.63 times; segment three, 5.83 times. Male pleopod 1 characterized by subdistal swelling.

Situation.—Among the species of *Glabropilumnus* and principally on the basis of the slimness of pereopods 2-5, only *laevis* Dana, 1952 seems relatively close to *P. suluensis. Pilumnus laevis* Dana, 1852 which was included by Balss (1933) in the genus *Glabropilumnus* was originally described from a female, size 4.41 x 6.19, collected from Balabac Strait. Except for its antero-lateral margin which was described as "three toothed, the teeth minute and like spines, the posterior much the smallest," the description of *P. laevis* agrees with that of *Pelianus suluensis* including the approximate locality from where collected and the size. De Man (1888) 66, Pl. 4, figs. 1 & 2, recorded two specimens of *laevis* (one male and one female), the largest male being of size 3.4 x 4.75. Basing our study on his illustrations which show somewhat stout and short ambulatory legs, we think that these specimens of De Man (1888) are not *P. laevis*. The senior author re-examined a series of specimens from Singapore identified by Balss (1938) as *Glabropilumnus laevimanus,* and who stated the importance of the variations in the series. It is our opinion that although some of these specimens might be *laevis,* they are somewhat close to *P. suluensis* because of the much slenderer pereopods. They are, however, different from *P. suluensis* because of the presence of spinelike antero-lateral teeth; the spinules on the anterior border of the merus of pereopods 2—5; and the typical male pleopods of the genus *Glabropilumnus.*

Family GONEPLACIDAE Dana, 1852

Subfamily GONEPLACINAE Miers, 1886

Genus GONEPLAX Leach, 1814

Goneplax Leach (1814) 393, 430; Miers (1886) 245; Alcock (1900) 316; Rathbun (1918) 25; Tesch (1918) 181; Yokoya (1933) 136; Sakai (1939) 563; (1965) 169; Barnard (1950) 283; Serene (1964) 189.

The Indo-Pacific species included in this genus are the following: *sinuatifrons* Miers, 1886, *maldivensis* Rathbun, 1902, *renoculis* Rathbun, 1914, *nipponensis* Tokoya, 1934, *wolfi* Serene, 1964, and *ockelmanni* Serene, 1971. These species may be distinguished from each other by the following key:

Key to the Indo-Pacific species

1. Strong and acute teeth absent on lateral border of carapace behind extraorbital angle 2
   At least an indication of one tooth on lateral border of carapace behind extraorbital angle 4

2 (1). Merus of pereopods 2 to 4 with subdistal spine on anterior border. On cheliped, merus with strong tubercle on posterior border, a subdistal spine on inferior border, and anterior border finely granular; carpus with spine on inner angle. Antennular basal segment occupies entire fossae, two succeeding segments which are both much longer than half frontal breadth, free. Male pleopod as in present paper .... *sinuatifrons*
   Merus of pereopods 2 to 4 without subdistal spine on anterior border. On cheliped, anterior border of merus finely granular; without spine on inner angle 3

3 (2). Merus of cheliped not exceeding far beyond lateral border of carapace with a minute spine situated a little behind the middle of posterior border. Male pleopod as in Takeda and Miyake (1968) fig. 7 d, e, and f .... *nipponensis*
   Merus of cheliped exceeding far beyond lateral border of carapace without even an indication of spine or tubercle on its posterior border. Antennular peduncle folded into antennular fossae. Carpus and dactylus of pereopod 5, flattened and broadened. Male pleopod as in present paper .... *ockelmanni*

4 (1). Pereopods 2 to 4 without subdistal spine on anterior border of merus. Extraorbital angle obtuse and retangular; eye peduncle club-shaped. Lateral border of carapace strongly convergent posteriorly. Propodus of pereopod 5, paddlelike .... *maldivensis*
   Pereopods 2 to 4 with subdistal spine on anterior border of merus; extraorbital angle 5

5 (4). Lateral border of carapace slightly convergent posteriorly; lateral teeth acute. Eye peduncle reniform. Male pleopod as in Takeda and Miyake (1968) fig. 8 c, d, and e .... *renoculis*
   Lateral border of carapace strongly convergent; eye peduncle club-shaped. Lateral teeth replaced by a cluster of three small ganules. Merus of cheliped with a spine on posterior border; carpus with a small spine on outer border .... *wolffi*

In spite of the mere indication of the presence of a tooth by only a feeble tubercle with three granules, the species *wolffi* was placed by Serene (1964) in his key in the group of species with a lateral tooth. According to Tesch (1918) the Mediterranean species *rhomboides* also belong to this group. The necessity for further investigation is insinuated in our inclusion in the present key of the characteristics features of the antennulae of two species. It is possible that, with reference to this character, the Indo-Pacific species of *Goneplax* should be separated into two different genera. This genus was originally described based on a European species which generic char-

acters need verification by a re-examination of the type species. It is possible that some, if not all, of the Indo-Pacific species belong to

GONEPLAX SINUATIFRONS Miers, 1886. **Plate 8, figs. 7-8; Text fig. 73.**

Goneplax sinuatifrons MIER (1886) 246, Pl. 20. fig. 2; TESCH (1918) 182, Pl. 9, fig. 2a.

Materials.—NMP 1519, one male, size 6.3 x 11, 3 ovigerous females, the largest 7 x 11, collected from Coronado and Siokun Bays by the Pele-Sule Tea Expedition 1964. The male with two chelipeds but without ambulatory legs; the largest female with two chelipeds and only one ambulatory leg; the others altogether without legs.

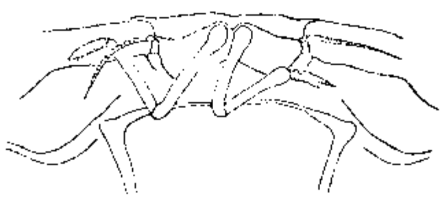
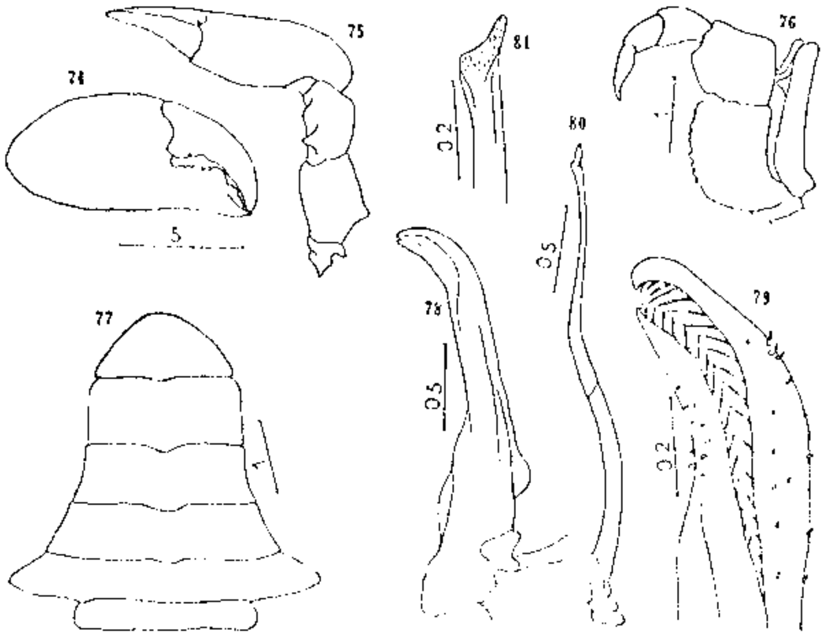


FIG. 73. Antennular region of *Goneplax sinuatifrons.*

History.—Miers (1886) described the species based on a female specimen, size 7 x 9.5 from Amboina where it was collected at a depth of 15 to 25 fathoms. Tesch (1918) recorded one male specimen, size 5.3 x 8.4, one female 6.5 x 9.25 and 8 juveniles, all from Amboina at a depth of 36 to 54 fathoms.

Observations.—Our specimens are much larger than all those previously recorded by authors. The differences in some characters noted by the present authors from those observed by Miers (1886) and Tesch (1918) are mainly due to the difference in the size of the materials used. In the male specimen, the merus of the cheliped exceeds far beyond the border of the carapace. The superior border of said merus a little before its middle bears a strong prominent tubercle; on the inferior (not anterior) border is present a small acute subdistal spine which has not as yet been mentoned by authors. The inner angle of the carpus of said cheliped is strong but not acute,

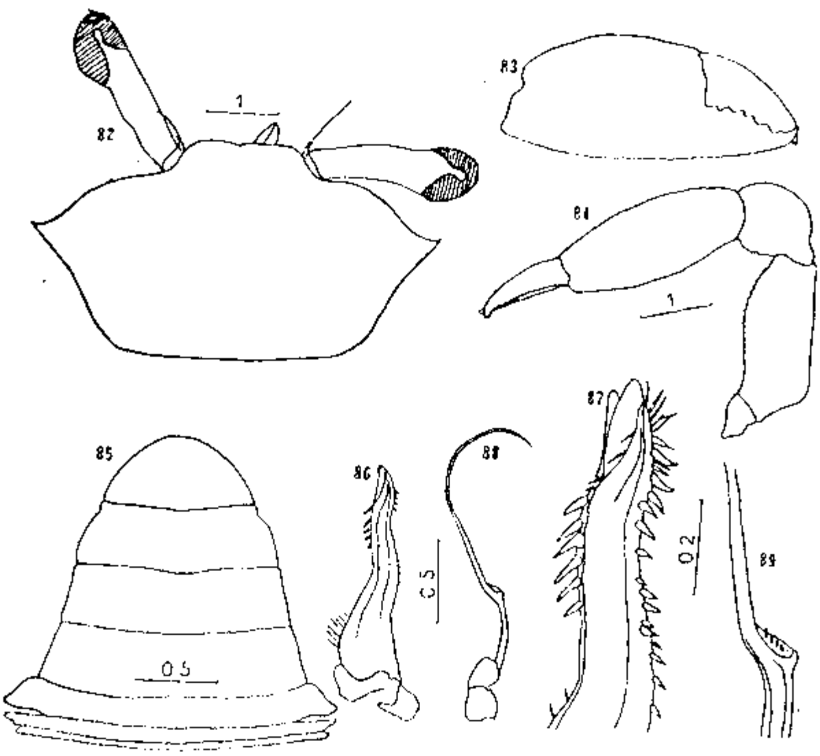


FIGS. 74-81. *Goneplax sinuatifrons* (male, size 6.3 x 11): *74-75*, right cheliped; *76*, third maxilliped; *77*, abdomen; *78-79*, pleopod 1; *80-81*, pleopod 2.

and there is not even an indciation of the presence of the small spine on the outer border as mentioned by Tesch (1918) in the description of his specimens. In the largest female specimen studied, the merus of the cheliped is comparatively shorter although it still exceeds far beyond the border of the carapace; on its superior border the tubercle is much smaller and less obtuse; on the inferior border the subdistal spine is larger; the inner angle of the carpus is much longer and more acute with an acute subdistal spine on the lower part of the outer border; the fingers are much longer than the superior border of the palm, which in the male are of the same lengths.

As was observed by Tesch (1918), the anterior margin of the front is not straight but rather it presents a median concavity. To be more precise, the front presents a round lobe on each side which are bent downward, and which are separated by a median concavity, the latter with a small, acute prominence. This concavity corresponds to the region of the articulation of the antennular peduncles which permits them to assume at least an oblique if not vertical,

position in relation to the dorsal surface of front. From dorsal view the anterior margin of the front appears sinuous. The description of the arrangement of the antennulae and the antennae in relation to the front, the orbit, and the buccal frame is perhaps necessary for a more adequate understanding. The antennular fossae being completely occupied by the large basal segment, the two long segments of the peduncle could not, therefore, be folded into them. The first two segments of the antennular peduncle are both much longer than half the breadth of the front, nearly as long as the total breadth. The two swollen basal antennular segments come together at the median axis, thus leaving, at least distally, practically no antennular septum between them. Laterally the antennular basal segments reach the orbital cavity where they form a small portion of its wall similar to what we find in the subfamilies Macrophthalminae and Scopomerinae as examples. The basal antennal segment occupies the orbital



FIGS. 82-89. *Goneplax ockelmanni* (male, size 3 x 5.2): *82*, outline of carapace; *83-84*, right cheliped; *85*, abdomen; *86-87*, pleopod 1; *88-89*, pleopod 2.

sinus, and the flagellum which is as long as the orbit, stands in the orbit. The two concavities which mark the outer half of the supra- and infraorbital borders correspond to the widening of the eye peduncle at the level of the cornea.

GONEPLAX OCKELMANNI Serene, 1971. Text figs. 82-89.

Goneplax ockelmanni, Serene, 1971 .... pl. 4 D

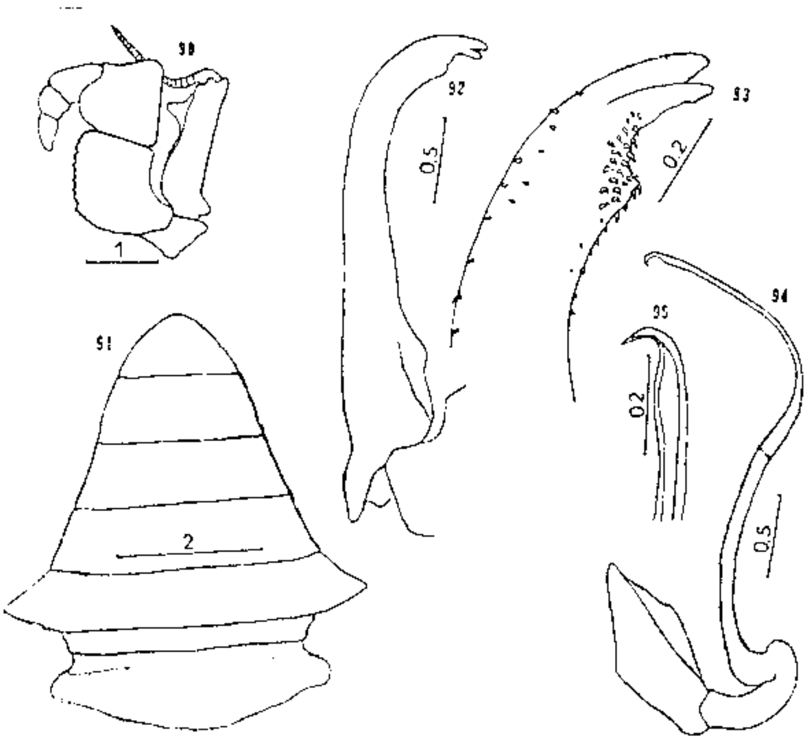
Materials.—One male, size 3 x 5.2, holotype; a smaller ovigerous female. Thai Danis Expedition 1966, Sta. 1004-9, T. 30 B. coll.

Definition and situation.—The carapace has the lateral border strongly convergent posteriorly and devoid of any indication of lateral teeth behind the strongly acute extraorbital angle. The almost straight front has a very faint sinus; the antero-lateral angles of the frontal margin are slightly bent downward. From the ventral view the two halves of the anterior frontal margins are only faintly concave. The antennulae are large with the flagella fitted below the anterior frontal margin when folded. The species is very close to *nipponensis* but differs by: *(1)* the absence of a submedian spine on the posterior border of the merus of the cheliped; *(2)* the more spinulous male pleopod 1, [Takeda and Miyake (1968) fig. 7d, e, and f for the male pleopod 1 of *nipponensis*]. *G. ockelmanni* is much more different from *sinuatifrons*, and these differences have to be particularly underlined. In *ockelmanni* the antennular basal segments do not fill the antennular fossae because these segments of the antennular peduncle are much shorter, being equal only to half the breadth of the front, and also because they could be folded into the antennular fossae below the frontal margin as is commonly observed in Brachyura. It is obvious to note that *ockelmanni* and *sinuatifrons* are not congeneric because the antennulae are not the only structures which are different but that also the male pleopod 1 are not similar. In *sinuatifrons* the pleopods 2 are comparatively shorter with the apex of the flagella not as acute as what is found in *ockelmanni*. The erection of a new genus will require the study of the other species of *Goneplax* especially the type species.

NOTONYX NITIDUS A. Milne Edwards, 1873. Plate 8, figs. 9-10; Text figs. 90-95.

Notonyx nitidus A. MILNE EDWARDS (1873) 296, Pl. 12, fig. 3; MIERS (1886) 236; ALCOCK (1900) 319; TESCH (1918) 219; BALSS (1938) 78; STEPHENSEN (1945) 172, fig. 47 A-B.

Material.–NMP No. 1522, male, size 7 x 9, the right cheliped and all other appendages lost; Pele-Sulu Sea Exped. 1964, South Lagoon, Sitankai, February 26, 1964.



FIGS. 90-95. *Notonyx nitidus* (male, size 7 x 9): *90*, third maxilliped; *91*, abdomen; *92-93*, pleopod 1; *94-95*, pleopod 2.

Observations.—The present specimen agrees with the accurate description of Tesch (1918). The male pleopod is identical with that illustrated by Stephenson (1945). With this specimen, the views of Tesch (1918) that the merus of the third maxilliped is shorter than the ischium, and that the type specimen is a female as shown in the illustration of its abdomen [A. Milne Edwards (1873) Pl. 12, fig. 3c] and not a male as described in the text of the same work are here fully confirmed. This species was originally described from a single specimen, size 7 x 9, from New Caledonia, and which type specimen is probably maintained in the National Museum of Natural History

in Paris. Miers (1886) records a specimen from off South New Guinea; Alcock (1900) one specimen, size 8.5 x 11, from the Persian Gulf; Tesch (1918) one male, size 4.6 x 6 and 4 females, the largest being 6 x 9, one ovigerous, size 3.9 x 5.8, all from the Java Sea region; and Stephensen (1945) specimens from Sunda Straits, Banda Sea and Kei Islands.

Family GRAPSIDAE Dana, 1852

Subfamily XENOPHTHALMINAE Alcock, 1900 comb. nov.

Xenophthalmidae STIMPSON (1858) 107 (in Latin); 1907, 140 (English translation published by Rathbun).

Xenophthalminae ALCOCK (1900) 258, 294; TESCH (1918) 271; STEPHENSEN (1945) 186.

Stimpson (1858 and 1907) established the family Xenophthalmidae based on *Xenophthalmus pinnotheroides.* Alcock (1900) established the subfamily Xenophthalminae based on the single genus *Xenophthalmus* with two species, namely, *pinnothenoides* and *obscurus*. Based on the last species *obscurus* as the type which we removed from the genus *Xenophthalmus*, the new genus *Neoxenophthalmus* is established and which we considered close to *Anomalifrons* Rathbun, (1929). Because in these three genera, the merus and the ischium of the third maxilliped are clearly separated, this particular character shows that the subfamilies Xenopthalminae and Anomalifrontinae must be excluded from the family Pinnotheridae and the family Xenophthalmidae Stimpson (1858) restored for them. This family is mainly characterized by the pronounced swelling of the pterygostomian region. The pseudo antero-lateral border of the carapace corresponds to the pterygostomian rim. The true antero-lateral border of the carapace is only faintly indicated by a feeble rim joining the posterior limit of the orbit to a notch corresponding to the junction of the pterygostomian rim with the lateral border of the carapace. The swelling of the pterygostomian region is especially most pronounced in *Xenophthalmus* (*pinnotheroides*) and is much lesser in both *Neozenophthalmus* (*obscurus*) and in *Anomalifrons* (*lightana*), the deeper and backward position of the orbit in *Xenophthalmus*, when compared to the other two genera, and which is due to the greater protrusion of the ventro-anterior portion of this region of the carapace. The characteristic feature of the anterior part of the buccal frame and the epistome provide the main difference between the two subfamilies. In Xenophthalminae, there is not even an indication of an epistome, and the buccal frame which is devoid of the median

piece opens into the ill-defined antennular fossae. In Anomalifrontinae, the buccal cavity is closed and is separated from the feeble epistome by the median piece of the buccal frame.

The following is a key for the separation of the subfamilies and the genera to which the three species (*X. pinnotheroides, N. obscurus,* and *A. lightana*) belong:

1. Buccal cavity with buccal frame devoid of median piece communicating anteriorly with antennular fossae; epistome absent. Xenophthalminae
   Buccal cavity closed anteriorly by median piece of buccal frame; small epistome present. Carapace, antennae, and pereopods nearly bare. Orbit directed obliquely backward and outward. Third maxilliped with small palp. A transverse rim across branchial and cardiac region. Male pleopod 1 nonspinulous at apex... Anomalifrontinae... *Anomalifrons*
2. Carapace covered by long fine setae and pereopods densely hairy. Orbits directed longitudinally backward. Third maxilliped with large hairy palp. No transverse rim across branchial and cardiac regions. Male pleopod 1 spinulous at apex .... *Xenopthalmus*
   Carapace, antennae, and pereopods almost bare. Orbits directed obliquely backward and outward. Third maxilliped with very small palp. A transverse rim across branchial and gastric regions. Male pleod 1 not spinulous at apex .... *Neoxenophthalmus*

Genus XENOPHTHALMUS White, 1846

Xenophthalmus WHITE (1846) 177; H. MILNE EDWARDS (1853) 220; BURGER (1894) 386; ALCOCK (1900) 332; TESCH (1918) 271.

The genus includes *X. pinnotheroides* White 1846, *obscurus* Henderson (1893), *duplociliatus* Sluiter (1881), and *latifrons* Burger 1895. The first two species will be re-examined. The other two which were considered by Tesch (1918) as abberant in the genus have never been rediscovered after the original authors reported on them. At most, we could state that *latifrons* in which the merus and ischium of the third maxilliped does not show even an indication of any separation between them [Burger (1894) Pl. 10, fig. 32] does not belong to Xenophthalmidae.

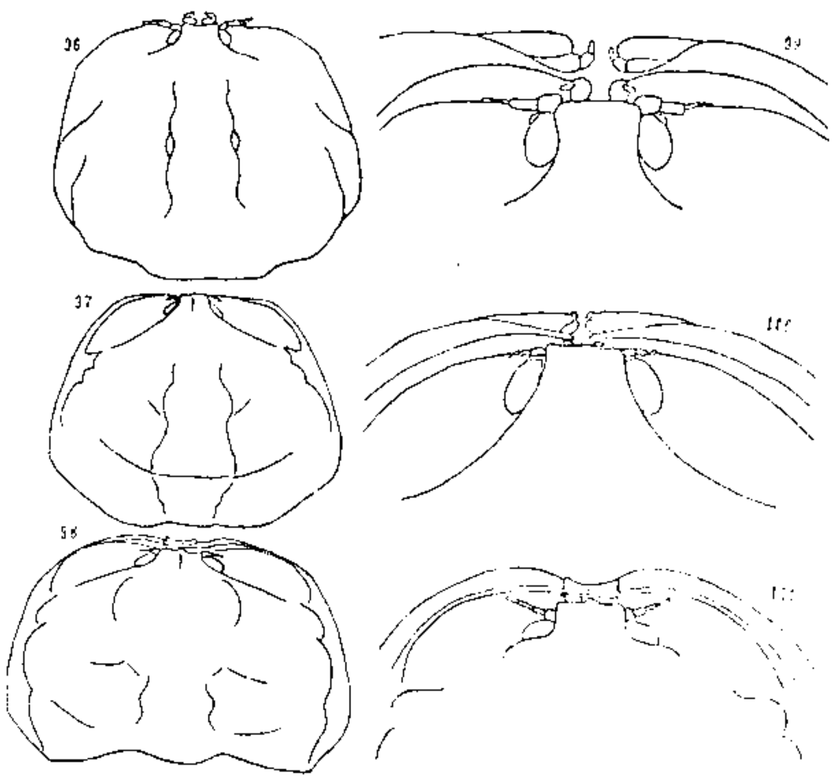
Xenophthalmus sensu stricto could be defined as follows: Carapace covered at least on the anterior part by soft long setae. All the appendages including the antennae are densely hairy. The orbits are directed longitudinally backward. The third maxilliped which has a gap between them has a large palp; the tip of the propodus nearly reaches the ischium; the dense-haired dactylus is turned outward and forward. The male pleopod which tapers distally has a strongly spinulous apex.

The type species: *Xenophthalmus pinnotheroides* White 1846; the type specimen is probably maintained in the British Museum. Presently two different species seem to be included under the name *pinnotheroides*. We are establishing *Neoxenophthalmus* gen. nov. for *Xenophthalmus* obscurus Henderson 1893.

XENOPHTHALMUS PINNOTHEROIDES White, 1846.

Plate 9, figs. 1-2; Text figs. 96, 99, 102-109.

Xenophthalmus pinnotheroides WHITE (1846) 177, Pl. 3, fig. 3; ADAMS and WHITE (1948) 63; Pl. 12, fig. 3; H. MILNE EDWARDS (1853) 221 (no specimen); STIMPSON (1858) 107; (1907) 141; SLUITER (1881) 162, not seen; HENDERSON (1893) 394; NOBILI (1900) 504; (1903) 19, ALCOCK (1900) 332; RATHBUN (1910) 338, fig. 22; TESCH (1918) 272; SHEN (1937) 301, text-fig. 11; (1948) 113, text-fig. 4; STHEPENSON (1945) 187, fig. 54; MIYAKE (1961) 175; TAKEDA and MIYAKE (1968) 574, fig. 10.



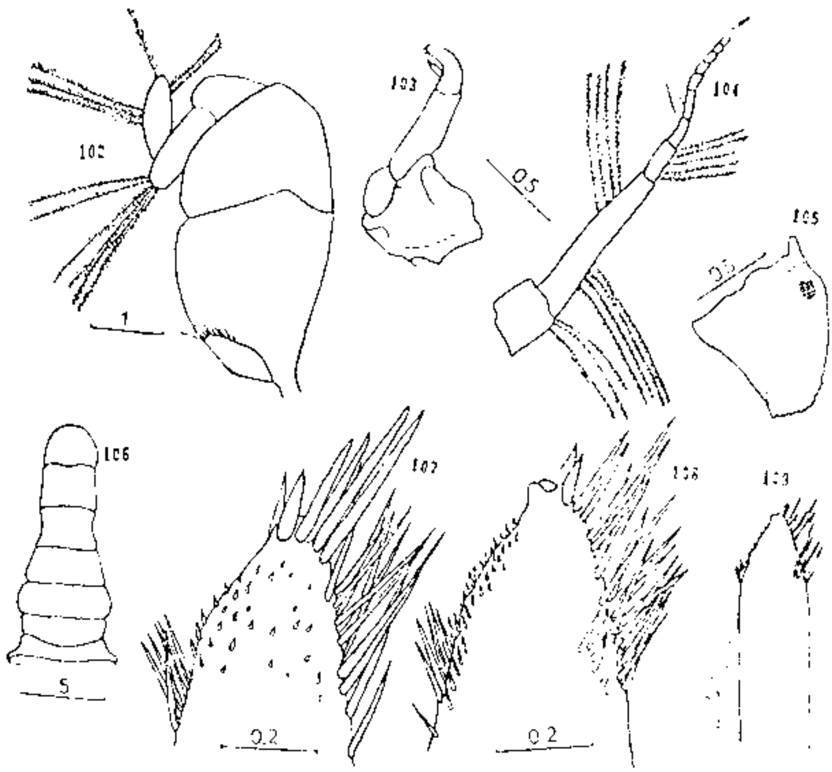
FIGS. 96-98. Outlines of carapace: *96, Xenophthalmus pinnotheroides; 97, Neoxenophthalmus boscurus; 98, Anomalifrons lightana.*

FIGS. 99-101. Fronto-orbital regions: *99, X. pinnotheroides; 100, N. obscurus; 101, A. lightana.*

Materials.—NMP No. 1199, male, size 11 x 15; male, size 8.5 x 11.5; female, size 10 x 14.5, from Busuanga, Palawan, collected by Dayrit and Norton on May 10–30, 1962; R.S. No. 526, male, size 9 x 12.5; male, size 9 x 12.5 from Penang collected by R. Serene; NMS 1965. 10. 4.10–19. female 6, male 4; the larger male 9 x 12. From fish traps Penang Straits; Fisheries Department 5–10 meters deep, June 1934—Tweedie determination; N.M.S. 1965. 10.4.1-9, one male 9 x 12, others juvenile, from Penang Straits, dredged in 5–8 meters depth, April 1935, Tweedie det.

History.—White (1846) and Adams and White (1848) described the species from the Philippines. H. Milne Edwards (1835) only quoted the species. Stimpson (1857, 1907) recorded the species from Hongkong. Henderson (1893) recorded the species from the Gulf of Martaban without mentioning the number and the size of the specimens. Alcock (1900) only referred to the specimens of Henderson. Nobili (1900) recorded one male and one female from Sarawak and in (1903) one female from Bombay. Rathbun (1910) recorded two males and one female, size 7.5 from the Gulf of Thailand. Tesch (1918) recorded 8 males and 11 females from Indonesia; the largest male, size 5.7 x 8.6, and the largest female, size 5.3 x 8. Shen (1937—1948) reporded the species from Kiaochow Bay, North China. Stephensen (1945) recorded 643 specimens from the Iranian Gulf, the larger female, size 8.5 x 10.5, and the largest size, 9 x 13. Takeda and White (1968) recorded from the Sea of Ariake, Japan, 8 males, the largest size 5.8 x 7.4 and 7 females, the largest 9.4 x 13.1.

Observations.—Our specimens agree with the description of Tesch (1918) and the illustrations of Shen (1937), and partly with the observations of Stephensen (1945). In our male specimen, size 11 x 15, the large chelipeds have large palm and strong fingers with a somewhat large subdistal tooth on the cutting edge of the dactylus as indicated in Shen (1937) fig. 11e, but is not shown in Stephensen (1945) fig. 54a. Also, in our specimen and in Shen's figure there is a sulcus on the outer face which runs parallel to the inferior border, but which is not found in Stephensen's figure. In our male, size 8 x 11.5, the palm although smaller, has the swollen palm and strong fingers already developed. Surprisingly in our two males, size 9 x 12.5 (R.S. No. 526), the chelipeds are not any different from those of the females. Similarly the presence of the large brush of dense setae on the underside of the carpus and the propodus of pereopod 3 is only observed in our two male specimens NMP



FIGS. 102-109. *Xenophthalmus pinnotheroides* (male, size 9 x 12.5): *102*, third maxilliped; *103*, antennula; *104*, antenna; *105*, eye penduncles, the dotted line indicating the border of the orbit; *106*, abdomen; *107*, pleopod 1; *108-109*, pleopod 1 in a specimen, size 11 x 15.

1199 which, not even its indication, could be observed in other males and never in the females.

The apex of the male pereopod 1 is similar to that illustrated by Shen (1932) fig. 11g, and Takeda and Miyake (1968) fig. 10 a, b, & c, from a specimen size, 5.7 x 7.6. In the largest specimens of more than 14 breadth, the pleopod 1, although somewhat similar to that illustrated by Stephensen (1945) fig. 54B, is very different in that, the largest spines are comparatively shorter and more numerous and, while the chitinous distal process is more developed, it is never elongate as in Stephensen's figure. The differences noted in the dactylus and palm of the cheliped as well as those of the male pleopod I simply suggest that the specimens of Stephensen, although very close to *pinnotheroides*, probably belong to a different species.[2]

[2] Now described as *Xenophthalmus wolfi* Takeda and Miyake, 1970.

In spite of the observation of Sliuter (1881), that this species is not commensal, still we are inclined to consider their probable association with annelida (Serene, 1964). The species lives in a large and cohesive community as illustrated by the Stephensen collection. It seems common in muddy bottoms of from 5 to 40 meters in depth, and where probably, the species lives commensal to a large population of annelida. It is widely distributed in the Indo-Pacific region, from the Gulf of Iran to the Philippines, Hongkong, China, and Japan.

Genus NEOXENOPHTHALMUS novum

Definition.—Carapace nearly bare; antennae small, very hairy. Orbits obliquely directed backward and outward. Third maxilliped with very small palp. Male pleopod slim, regularly tapering toward apex, without subdistal spinules. *Xenophthalmus obscurus* Henderson (1893) is the type species, the specimen probably being maintained in the British Museum.

NEOXENOPHTHALMUS OBSCURUS Henderson, 1893.
Plate 9, fig. 3; Text figs. 97, 110-116.

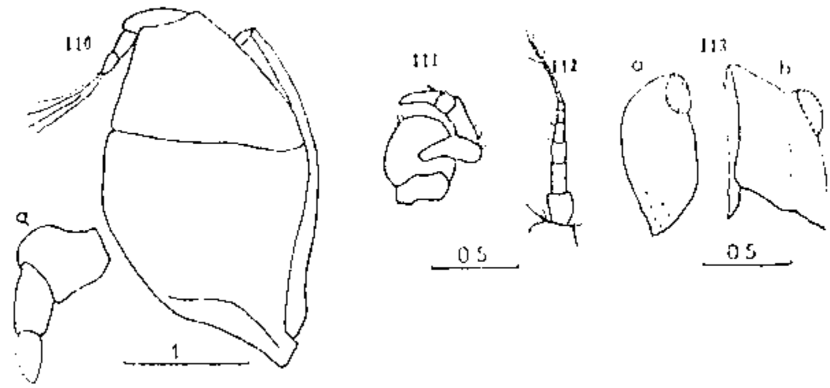
Xenophthalmus obscurus HENDERSON (1893) 394, Pl. 36, figs. 18 & 19; ALCOCK (1900) 333; RATHBUN (1910) 338, Text-fig. 23 a–c, Pl. 2, fig. 14; TESCH (1918) 272 (in the key only).

Materials.—NMS. 1965. 7.9.8, male, size 8.6 x 12; NMS. 1965. 7.9.9, male, size 9 x 12; NMS. 1965. 7.8.10, male, size 7.5 x 9.8; NMS. 1965. 7.9.11, male, size 7.5 x 9.8; NMS. 1965. 7.9.12, female ovigerous, size 7 x 9.5; NMS. 1965. 7.9.13 ovigerous female, size 7 x 9.5, from Port Swettenham, dreged in from 6 to 10 meters depth, December 1934, Tweedie determination, not recorded.

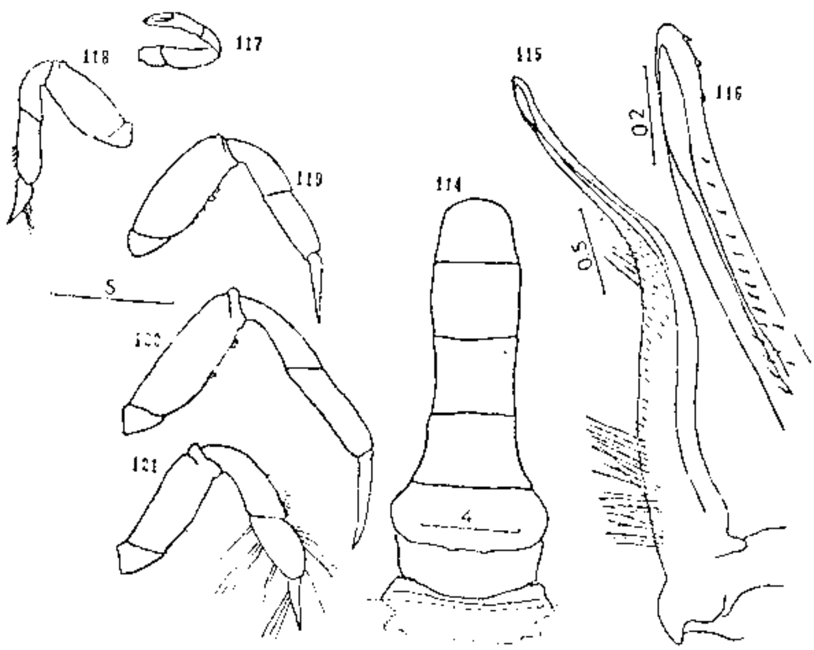
History.—Henderson (1893) described the species based on a female specimen with a size of 5.7 x 6. Alcock (1900) recorded two females, one ovigerous from off the Ganjam Coast, and the other from the Adamans, the largest being 6 x 8. Rathbun (1910) recorded 20 males and 23 females from the Gulf of Thailand but identified them as Henderson's species with reservations.

Observations.—Our specimens are similar to those well illustrated by Rathbun (1910). In the largest male specimens, the chelipeds are very similar to those of the females. In addition to generic characters already mentioned in the separation of *obscurus* from *pinnotheroides* several other features may be cited. In *obscurus*, the eyes are more developed with distinct cornea organized as a well-delimited and salient vault, while in *pinnotheroides*, only a diffused

patch of pigment is visible by transparency. In *obscurus* a discontinuous transverse rim runs at the level of the cardiac region separatnig the smooth anterior part of the carapace from the somewhat



FIGS. 110-113. *Neoxenophthalmus obscurus* (male, size 6 x 12): *110*, third maxilliped — *a* palp much enlarged; *111*, antennula; *112*, antenna; *113*, eye peduncles — *a* dorsal view and *b* lateral view.



FIGS. 114-121. *Neoxenophthalmus obscurus* (male, size 6 x 12): *114*, abdomen; *115-116*, pleopod 1; *117*, right cheliped; *118*, left pereopod 2; *119-121*, right pereopods 3, 4, and 5

posterior part; this particular feature is not found in *pinnotheroides.* Pereopods 2 – 4 are less modified in *obscurus* than in *pinnotheroides.* [Stephensen (1945) fig. 54]. The telson in the male abdomen of *obscurus* is comparatively shorter with a tranverse depression at the margin of its proximal third, corresponding to a constriction of its lateral border. Segment 5 is definitely much longer than broad with a straight lateral border in contrast to that in *pinnotheroides* which is much broader than long with a concave lateral border. Segment 1 is, likewise, comparatively shorter. The male pleopod 1 in the two species are very different from each other. The generic differences concerning the third maxilliped, orbit, and antenna could be clearly seen by comparing the figures of Rathbun [(1910) fig. 23] for *obscurus* and Rathbun [(1910) fig. 22] for *pinnotheroides* The generic significance of the palp of the third amxilliped of *Xenophthalmus* could be better appreciated by referring to the accurate illustration of Shen [(1937) fig. 11].

Genus ANOMALIFRONS Rathbun, 1929

ANOMALIFRONS LIGHTANA Rathbun, 1929. Plate 9, fig. 4; Text figs. 122-123.

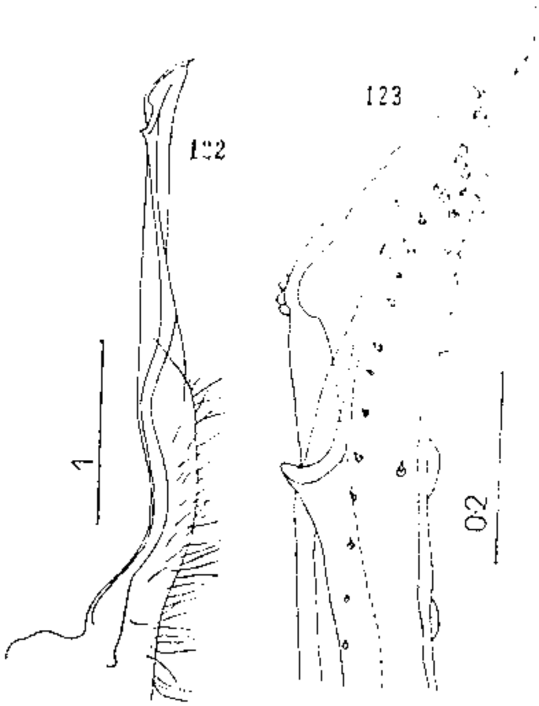
Anomalifrons lightana RATHBUN (1929) 85, Pl. 13, figs. 37, 38, 39.

Materials.—NMS. 1965. 10.4.20-22, male, size 6 x 9; male, size 4 x 5.8; NMS. 1965. 7. 9.7, male, size 5.25 x 8.5, from Penang Straits, dreged from 6.9 meters deep, April 1935, *Xenophthalmus* sp., Tweedie determination.

History.—Rathbun (1929) described the species based on one specimen collected at Fukien, (China) by Mr. Light, and on two other specimens, one male and one female from Foochow. The type, Cat. No. 61879, a male with a carapace of 9.8 x 14.8 is presently maintained in the United States National Museum.

Observations.—The particular morphological features of the anterior region left little doubt as to the identity of the specimens as *Anomalifrons lightana.* In comparing our specimens with the description and illustraitons of Rathbun (1929) it was observed that the chelipeds in our two larger specimens, have not as yet attained the complete development reached by the larger-sized type specimen. The immaturity of our present specimen may be further observed by referring to the illustration of its pleopod which is indicative.

Basing on the ratio of the length of the carapace to its breadth A. *lightana* is closer to X. *pinnotheroides* than to N. *obscurus.* On the basis of the lightness of its antenna, antennula, the palp of the third maxilliped, and the dorsal relief of the carapace, A. *lightana* is closer to N. *obscurus* than to X. *pinnotheroides.*



FIGS. 122-123. *Anomalifrons lightana* (male, size 5.25 x 8.25): pleopod 1.

Family OCYPODIDAE Ortmann, 1894

Subfamily CAMPTANDRIINAE, Stimpson, 1858, comb. nov.

Camptandriidae, Stimpson, 1858, 106 — 1907, 37.

Genus SHENIUS Serene, 1971

Shenius, Serene, 1971

Definition.—Carapace broader than long, its surface uneven with tubercles symmetrically arranged; antero-lateral margins with three rounded teeth. Cheliped with merus granulated on margins; carpus longer than broad; propodus in male swollen; dactylus with a big proximal denticulated tooth. Third maxillipeds completely closing buccal cavity. Antenna standing in orbital hiatus longer than orbit. Ambulatory legs slender but not hairy, with three separate spines on anterior border of merus. Male abdomen with a pronounced constriction on segment 5. Male pleopod 1 with several strong spines near apex.

The type species is *Camptandrium anomalum* Shen, 1935.

Position.—Suggestive of the name *anomalum*, the species was aberrant in the genus *Camptandrium* because of the many characteris-

tic features of the carapace, the pereopods, and the abdomen and pleopod 1 in the males of the species. These discrepant characters justify the transfer of *anomalum* to another genus, and the retention in the genus *Camptandrium* of only the species with the male pleopod 1 folded and bifurcate at the apex such as in *sexdentatum* Stimpson (1858) and *elongatum* Rathbun (1929). Stimpson (1858 & 1097), in his definition of *Camptandrium* stated, "The male abdominal appendages of the first pair are long, slender, bent or geniculated beyond the middle where there is a strong tubercle or papilla on the convex side, and contorted towards their extremities." The male pleopod 1 of the two species is illustrated by Shen [(1932) fig. 140e] for *sexdentatum* and Shen [(1935) fig. 10b] for *elongatum.*

A comparison of specimens of *anomalum* and *elongatum* shows that they differ in carapace, front, antennula, antenna, epistome, chelipeds, ambulatory legs, male abdomen, and male pleopod.

Shen (1945) described *anomalum* as *Camptandrium* because of its similarity in general aspect to *paludicola.* Although there exists some similarities in the carapace and pereopods in the two species, *anomalum* could not be placed in the genus *Ilygrapsus* with *paludicola* because the male abdomen and the pleopods of *anomalum* differ from that of the single species of *Ilyograpsus* in spite of the apparent relationship indicated by Shen in his key to the species of *Camptandrium,* and therefore, could not be regarded as congeneric. Furthermore, *anomalum* belongs to the family Ocypodidae with buccal cavity completely losed by the third maxillipeds, one of the characteristics features present in several genera of this family. The third maxilliped in *anomalum* is convex, with the merus a little longer than the isichium, the palp being articulated at the middle of the anterior border of the merus. These type of maxillipeds are close to the *Camptandrium* species as shown in the illustration for *C. elongatum* in the present paper, and for *C. sexdentatum* in Kemp [(1915) fig. 14]. The male abdomen with the characteristics submedian constriction is comparatively similar to those of the many genera in the subfamilies Macrophthalminae and Scopimerinae.

The genus *Shenius* is closer to *Camptandrium* and *Leipocten* than to the other genera in Macrophthalminae. These two genera, like *Shenius,* are aberrant in the subfamily, and therefore, their classification here must be considered provisional only. Stimpson (1858) established the family Camptandriidae mainly for his genus *Camptandrium* because it could not be fitted into either Grapsidae or Goneplacidae. Tesch (1918) stated "that it is evidently one of the Ocypodidae and that its natural place is among the Macrophthalminae."

Camptandriidae Stimpson 1858 is restored only to the subfamily level under the family Ocypodidae and included in it are at least the genera *Camptandrium*, *Shenius*, and *Leipocten*.

SHENIUS ANOMALUS Shen, 1935. Plate 9, figs. 5-7; Text figs. 124-125.

Camptandrium anomalum SHEN (1935) 31, text-fig. 8 b, 9 a-d; TWEEDIE (1937) 162.

Materials.—NMS. 1965.7.8.18, male, size 3.8 x 4.5; NMS. 1965. 7.9.19, male, size 2 x 2.5; NMS. 1965.7.9.20, female, size 4.5 x 5.8 and and female, size 5 x 6; NMS. 1965.7.15.24, ovigerous female, size 3.5 x 4, male, size 2.5 x 3, from Johore Straits; 10/1934, Tweedie (1937) determination; NMS. 1965.7.15. 1.—8, 7 females, the larger ovigerous, size 4.5 x 6, 1 male, size 2.5 x 3, from Kranji River; 6/1935, Tweedie determination; NMS. 1965.7.15.9, 1 female, from Muar, Johore, Malaysia; 2/1936, Tweedie det., NMS. 1965.7.15.14—23, 12 females, 5 males, the larger size, 4 x 4.5, from Mersing, Johore, Malaysia; 11/1938, T/weedie det.; NMS. 1965.7.15.10—13, 3 females, 1 male,

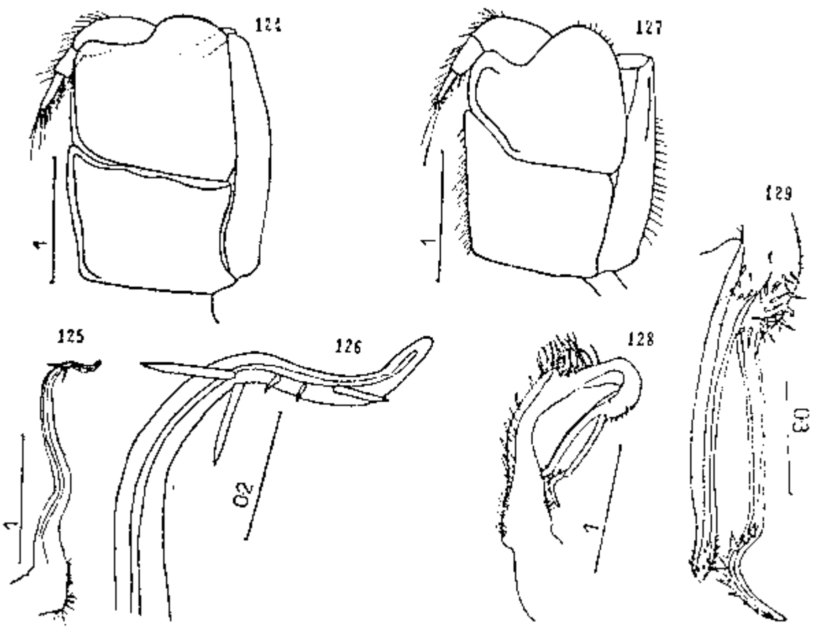


FIG. 124-126. *Shenius anomalus* (male, size 3.8 x 4.5): *124*, third maxilliped; *125-126*, pleopod 1.

FIGS. 127-129. *Camptandrium elongatum* (male, size 6 x 5): *127*, third maxilliped; *128-129*, peopod 1.

size 3.5 x 4; from Prai, Wellesley Province, Malaysia; 12/1938, Tweedie det.

History.—Shen (1935) described *anomalum* on one male, size 3.5 x 4.5 (the type specimen) and one female from Taipo, near Canton, from muddy flats. Tweedie (1937) recorded the species from Singapore.

Observations.—Shen (1935), in his description, gave figures of the outline of the suborbital border (fig. 8b), carapace (fig. 9a), merus of the second ambulatory legs (fig. 8b), male abdomen (fig. 9c) and the first male pleopod (fig. 9d). Our illustrations for this species will be of assistance in comparing it to *Camptandrium elongatum.*

Tweedie collected this species from various localities in Malaysia where it is relatively common in mangroove swamps.

Genus CAMPTANDRIUM Stimpson, 1858

CAMPTANDRIUM ELONGATUM Rathbun, 1929. Plate 9, figs. 8-9; Text figs. 127-129.

Camptandrium elongatum RATHBUN (1929) 95, Pl. 13, figs. 40, 43; SHEN (1935) 33, text-figs. 8c, 10; TWEEDIE (1937) 161.

Materials.—NMS. 1965.7.15.45-53, series of females, the larger size 6 x 5, from Pulao Seletar, Johore Straits; 6/1934, Tweedie determination; NMS. 1965.7.15.25-23, female, from Pandan Forest Reserve, Singapore, 7/1934, Tweedie (1937) det.; NMS. 1965. 10.5.1-83, males, 16 females, from Buloh River, Johore, 8/1934, Tweedie (1937) det.; NMS. 1965.7.9.21, male, size 4.75 x 4; NMS. 1965.7.15.34-44, 8 males, the larger size 4.8 x 4.1, 16 females, the larger size 7 x 6, ovigerous, from Kuantan, Pahang, 9/1935, Tweedie (1937) det.

History.—Rathbun (1929) described *elongatum* on a female, size, 7.2 x 6.8, holotype, from Luiwutien, near Amoy, China, and recorded 4 males and 8 females also from China; the larger male, size 5 x 4.4. Shen recorded 6 males and 8 females from near Canton, China. Tweedie (1937) specimens from near Singapore.

Observations.—Some of Tweedie's specimens were used as comparative materials to justify the removal of the species *anomalum* from the genus *Camptandrium.* The species is common in Malaysia, and the senior author who collected many specimens is of the opinion that it occurs in all the shores of the Indo-Malayan region.

Family GRAPSIDAE Dana, 1852

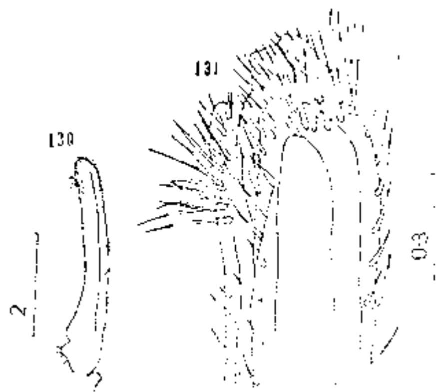
Subfamily VARUNINAE Alcock, 1900

THALASSOGRAPSUS HARPAX (Hilgendorf, 1892). Plate 9, fig. 10; Text figs. 130-131.

Brachynotus harpax HILGENDORF (1892) 38; DE MAN (1895-98) 124, Pl. 29, fig. 26 a-d; NOBILI (1906) 320; PESTA (1912) 62; RATHBUN (1929)

88; SAKAI (1939) 675. Text-fig. 119 a-c.
Thalassograpsus harpax TWEEDIE (1950) 134, fig. 4 a-b.

Materials.—RS. 531, male, size 5 x 6 from the University of the Philippines collection, a dry specimen, now on deposit in the National Museum of the Philippines; NMS. 1965.7.9.22, male, size 10.5 x 12, from Cocos-Keeling Island, 1941 C.A. Gibson-Hill Coll. Tweedie (1950) det.



FIGS. 130-131. *Thalassograpsus harpax* (male, size 10.5 x 12): pleopod 1.

Observations.—Tweedie (1950, fig. 4a, b), in establishing the genus *Thalassograpsus* based on the species *harpax*, gave a short description of the species itself, and illustrated principally the fronto-orbital region (Fig. 4a) as a generic character together with the chelae of the adult male with fingers widely gaping (Fig. 4b). With reference to the present specimens under study, the two chelipeds in the adult males are not only enlarged as stated by Tweedie (1950), but that in the left cheliped the dactylus has a strong tooth which is not present in the right as illustrated by Tweedie. The male pleopod 1 is also illustrated.

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ADDENDUM

When the present report was in press, the senior author had the opportunity to examine at the Western Australian Museum (WAM), a large collection of brachyura collected during the Pele Expedition in the Sulu Sea in 1964. With reference to the species studied in the present report, the following records are added:

Ranilia misakensis

— WAM 146-70, Loc: South Pangkao Is., off Bohol Is., Philippines, Source: M. King on "Pele", Date coll: 8.11.1964, Det: P.S. Woods, 40-77 faths., sandy.

Notosceles chimmonis

— WAM 128-70, female of 33 x 22, Loc: 4½ miles, 2n' from Zau Is., Pearl: Bank, Sulu Arch., Source: B. R. Wilson on "Pele", Date coll: 22/11/1964.

— WAM 131-70, 13 faths., sand + lithothammion, Loc: 9 miles N.S.W. of E. Melville, Balabac Is., Palawan, Sulu Sea, Source: B. R. Wilson on "Pele," Date coll: 10/11/1964, 25-28 faths., sand.

Raninoides hendersoni

— WAM 139-70, male of 31 x 19, Loc: 8-9 miles S.W. of Cagayan Sulu Is., Sulu Sea, 50-54 faths., Source: B. R. Wilson on "Pele", Date coll: 6.11.1964, sand muddy.

— WAM 141-70, Loc: South Pangkao Island off Bohol Is., Philippines, Source: M. King on "Pele", Date coll: 8-11.1964, 40-77 faths., sandy.

— WAM 142-70, Loc: near Pangkao Is. off Bohol Is., Philippines, Source: M. King on "Pele", Date coll: 7.11.1964, 45-70 faths., mud + sand.

ILLUSTRATIONS

PLATE 1

Ranilia orientalis (Male, size 43 x 30):

FIG. 1. Entire animal, dorsal view.
2. Anterior frontal view.
3. Third maxilliped.
4. Cheliped, outer view.
5. Pereopod 4.

Ranilia misakiensis (Male, size 37 x 29):

FIG. 6. Dorsal view of carapace.
7. Antero-frontal view.
8. Third maxilliped.
9. Abdomen.
10. Cheliped, outer view.

PLATE 2

Ranilia misakiensis (Male, size 37 x 29):

FIG. 1. Lateral view of abdomen with pleopods 1 and 2.
2. Pleopod 1, outer view.
3. Pleopod 5 with penis of coxa.
4. Dactylus of pereopod 3.
5. Dactylus of pereopod 4.

Raninoides personatus (Female, size 31 x 12):

FIG. 6. Entire animal, dorsal view.
7. Cheliped, inner view.
8. Sternal shield.

PLATE 3

Raninoides hendersoni (Male, size 18 x 10.5):

FIG. 1. Entire animal, dorsal view.
2. Anterior part of carapace, dorsal view.
3. Right cheliped, inner view.

Notosceles chimonis (Female, size 33 x 16):

FIG. 4. Entire animal, dorsal view.
5. Sternal shield.
6. Cheliped, ihner view.

Notosceles serratifrons (Female, size 20 x 11):

FIG. 7. Entire animal, dorsal view.
8. Anterior part, dorsal view.
9. Cheliped, inner view.
10. Cheliped, outer view.

PLATE 4

Cyrtorhina balabacensis (Female, size 38 x 33):

FIG. 1. Entire animal, dorsnl view.
2. Entire animal, ventral view.
3. Anterior part, dorsal view.
5. Sternal shield.
6. Abdomen.
7. Antenna.
8. Cheliped, outer view.

Nautilocorystes investigatoris (Female, size 10.5 x 10.5):

FIG. 9. Entire animal, dorsal view.
10. Cheliped.

PLATE 5

Oreophorus (Tlos) muriger (Female, size 9 x 13, NMP, Manila):

FIG. 1. Dorsal view, anterior part turned up.
2. Dorsal view, posterior part turned up.
3. Dorsal view, female, size 7 x 12, Copenhagen Museum.
4. Dorsal view, anterior part turned up, male, size 7.4 x 12.2, Copenhagen Museum.
5. Dorsal view, posterior part turned up, male, size 7.4 x 12.2 Copenhagen Museum.

Pathenope (Rhinolambrus) sisimanensis (Male, size 6 x 11):

FIG. 6. Entire animal, dorsal view.
7. Carapace, lateral view.
8. Anterior region, ventral view.

Daldorfia spinossisima (Male, size 100 x 153):

FIG. 9. Entire animal, dorsal view.
10. Anterior portion of carapace with right cheliped.

Elamenopsis lineatus (Female, size 2.3 x 3.3):

FIG. 11. Carapace, dorsal view.

PLATE 6

Guinotellus melvillensis (Male, size 12 x 14):

FIG. 1. Carapace, dorsal view.
2. Carapace, ventral view.
3. Third maxilliped.
4. Antennular region.
5. Subhepatic cavity.
6. Abdomen.

Medaeus elegans (Male, size 11 x 14):

FIG. 7. Dorsal view.
8. Ventral view.
9. Antennular region.
10. Cheliped.

PLATE 7

Medaeops granulosus:

FIG. 1. Dorsal view of carapace of a female, size 9.5 x 14.3.
2. Antennular region of a male, size 11 x 16.6.

Paramedaeus simplex (Male, size 9 x 14):

FIG. 3. Entire animal, dorsal view.
4. Carapace.
5. Abdomen.
6. Antennular region.

Paramedaeus noelensis (Male, size 5.5 x 8.5):

FIG. 7. Carapace, dorsal view.
8. Carapace, ventral view with chelipeds.
9. Antennular region.

Medaeus rouxi (Female, size 5.5 x 8):

FIG. 10. Entire animal, dorsal view.

PLATE 8

Calmania simodaensis (Male, size 7 x 8):

FIG. 1. Entire animal, dorsal view.
2. Entire animal, ventral view showing abdomen.
3. Cheliped.
4. Antennular region.

Peleianus suluensis (Male, size 5 x 6.5):

FIG. 5. Entire animal, dorsal view.
6. Carapace.

Goneplax sinuatifrons (Male, size 6.3 x 11):

FIG. 7. Dorsal view.
8. Carapace.

Notonyx nitidus (Male, size 7 x 9):

FIG. 9. Dorsal view.
10. Cheliped.

PLATE 9

Xenophthalmus pinnotheroides (Male, size 9 x 12):

FIG. 1. Entire animal, dorsal view.
2. The chelipeds.

Neoxenophthalmus obscurus (Male, size 9 x 12):

FIG. 3. Entire animal, dorsal view.

Anomalifrons lightana (Male, size 6 x 9):

FIG. 4. Entire animal, dorsal view.

Shenius anomalus (Male, size 3.7 x 4.5):

5. Entire animal, dorsal view.
6. Carapace enlarged.
7. Abdomen.

Camptandrium elongatum (Male, size 4. 6 x 4. 3):

FIG. 8. Abdomen.
9. Entire animal showing carapace and portions of legs, dorsal view.

Thalassograpsus harpax (Male, size 10.5 x 12):

FIG. 10. Entire animal, dorsal view, showing carapace, chelipeds and portions of legs.

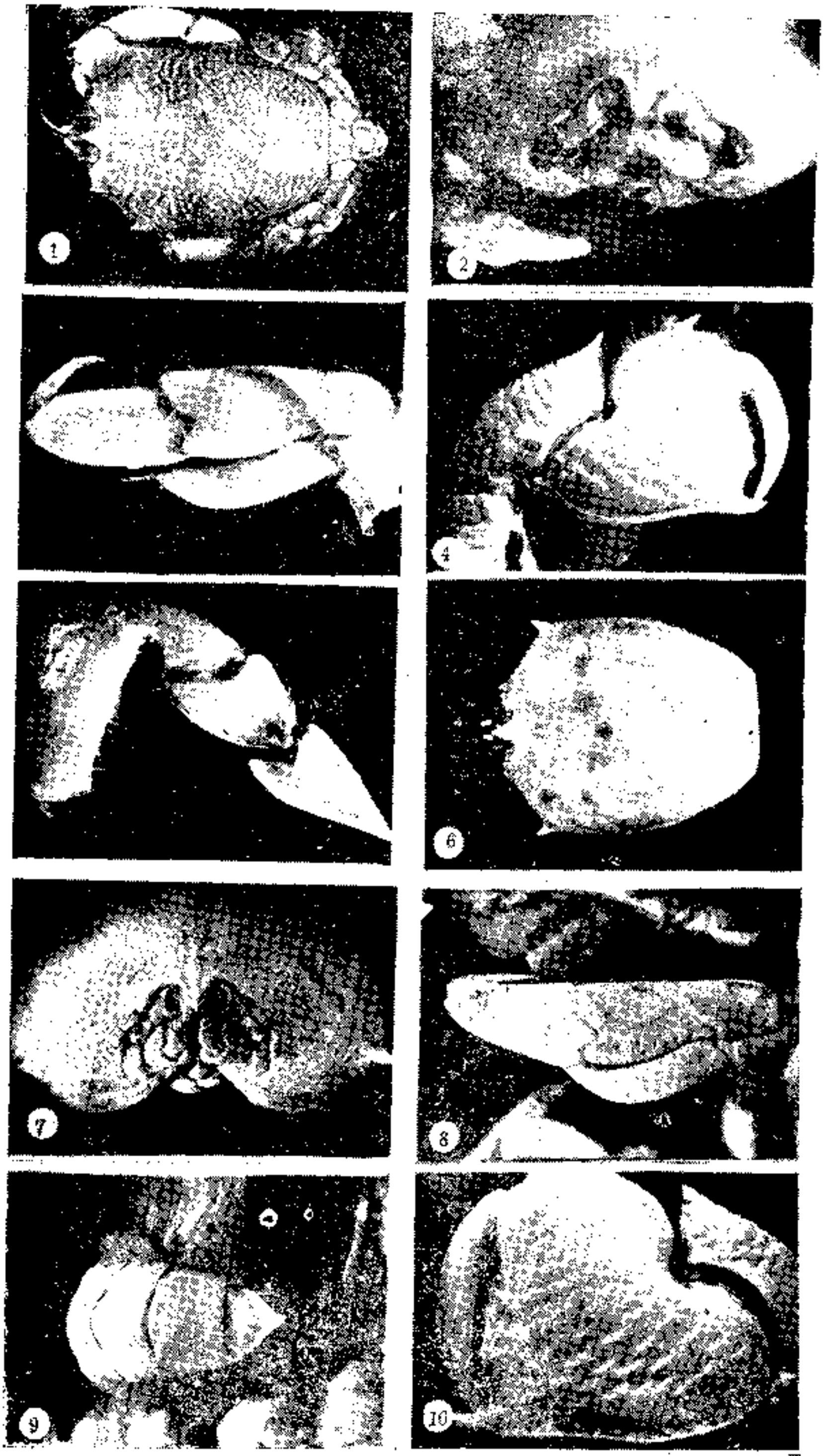
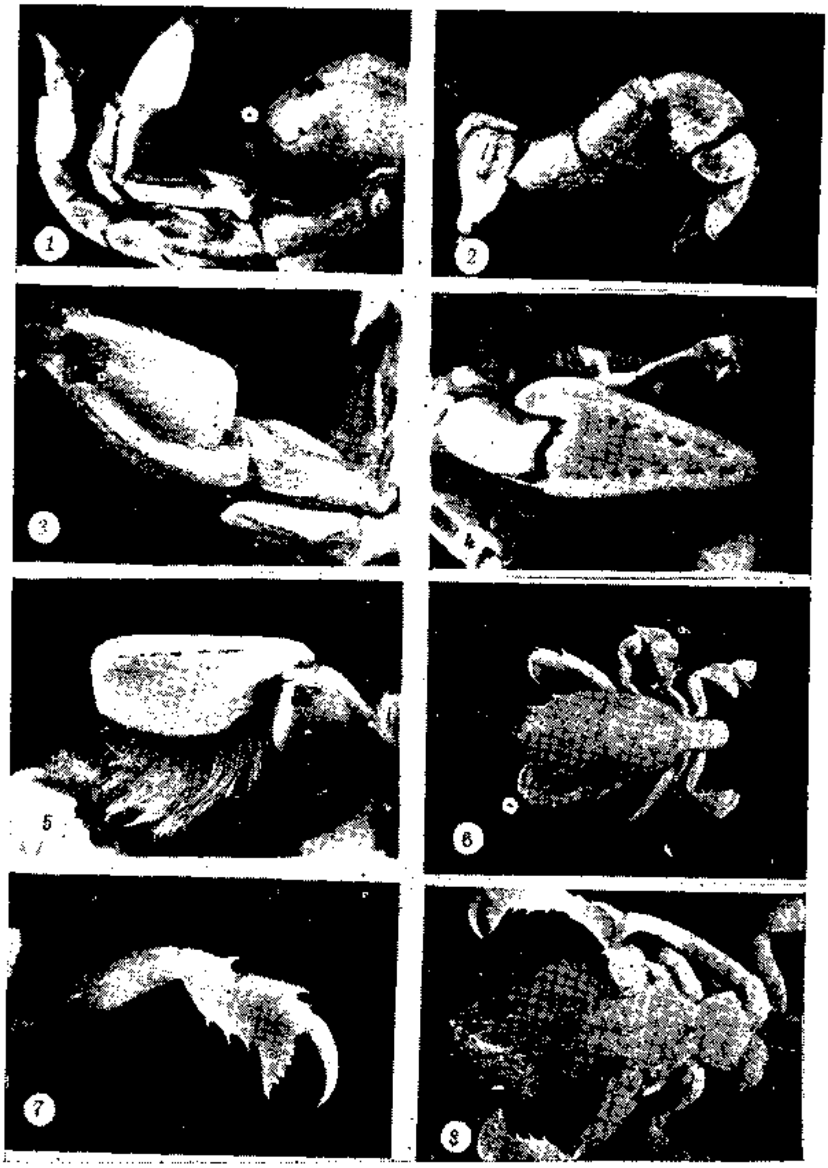


PLATE I.



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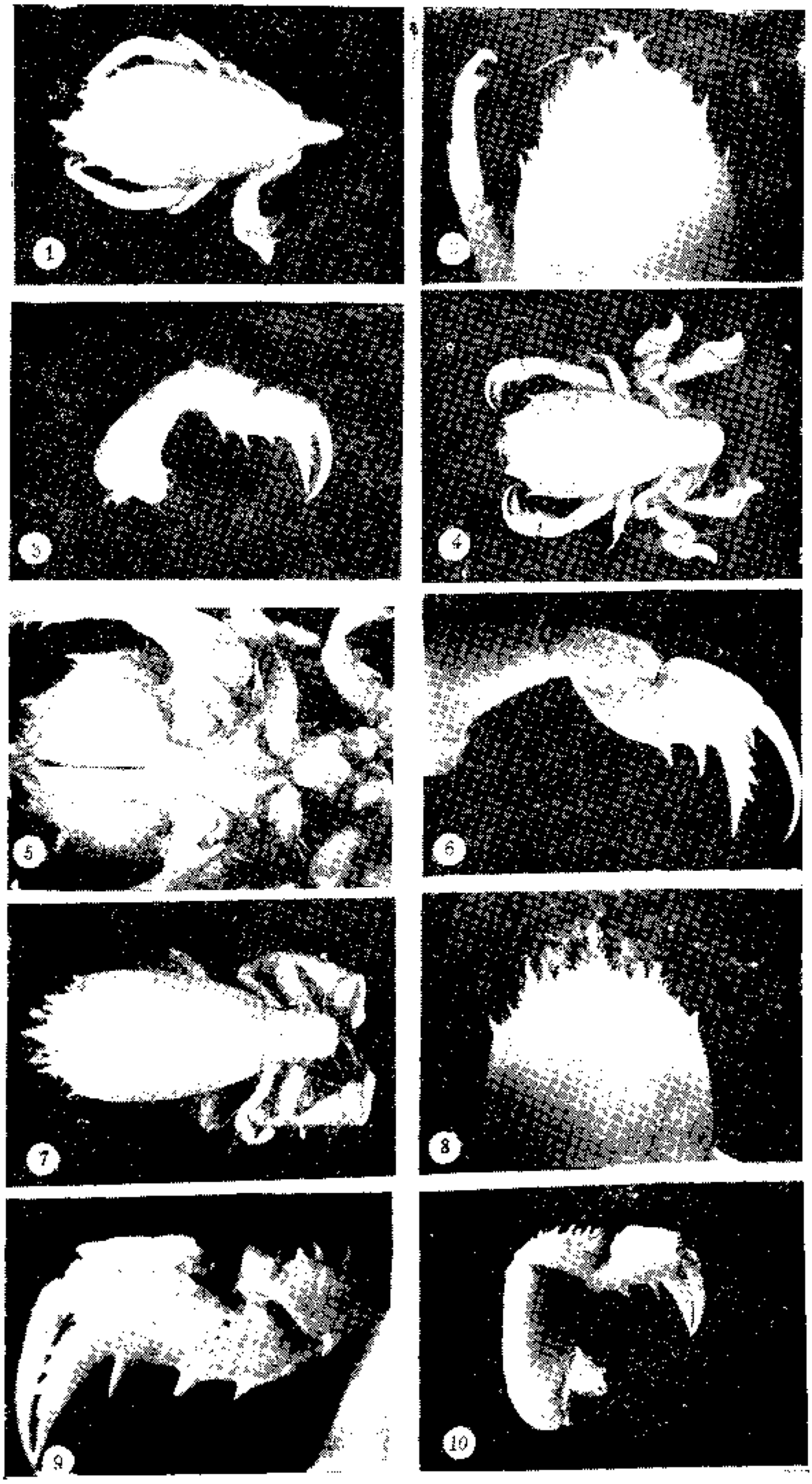

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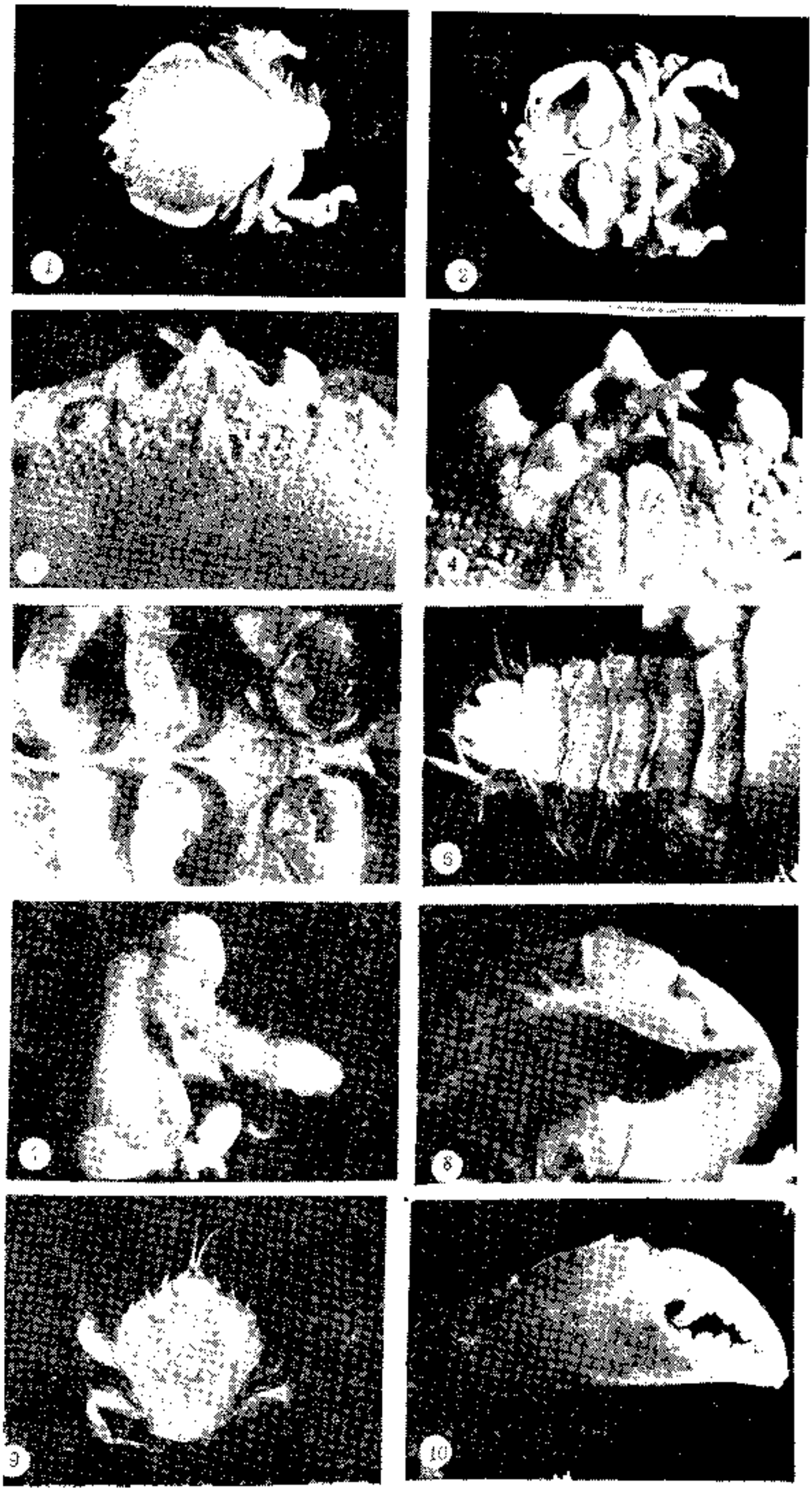

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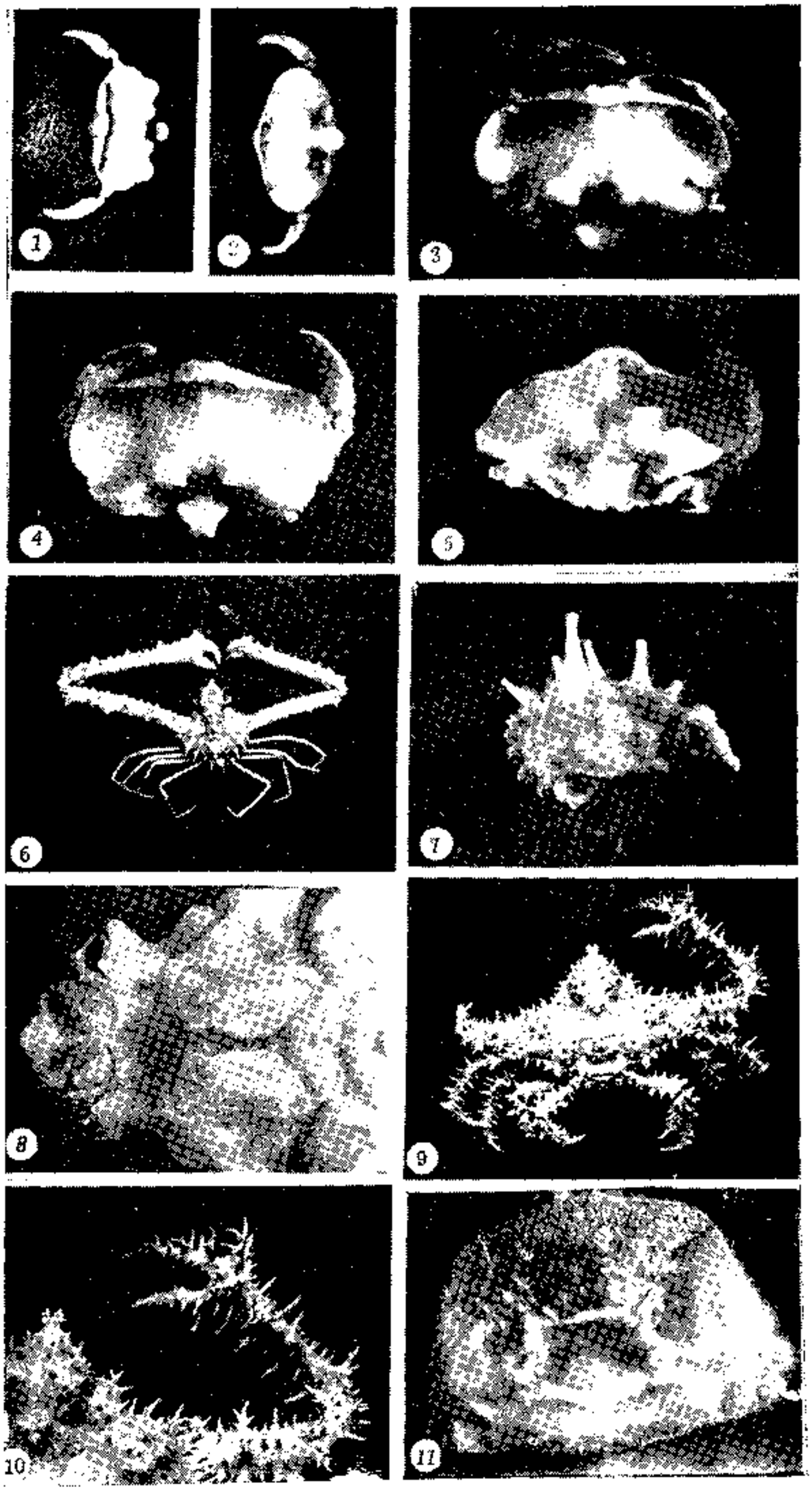

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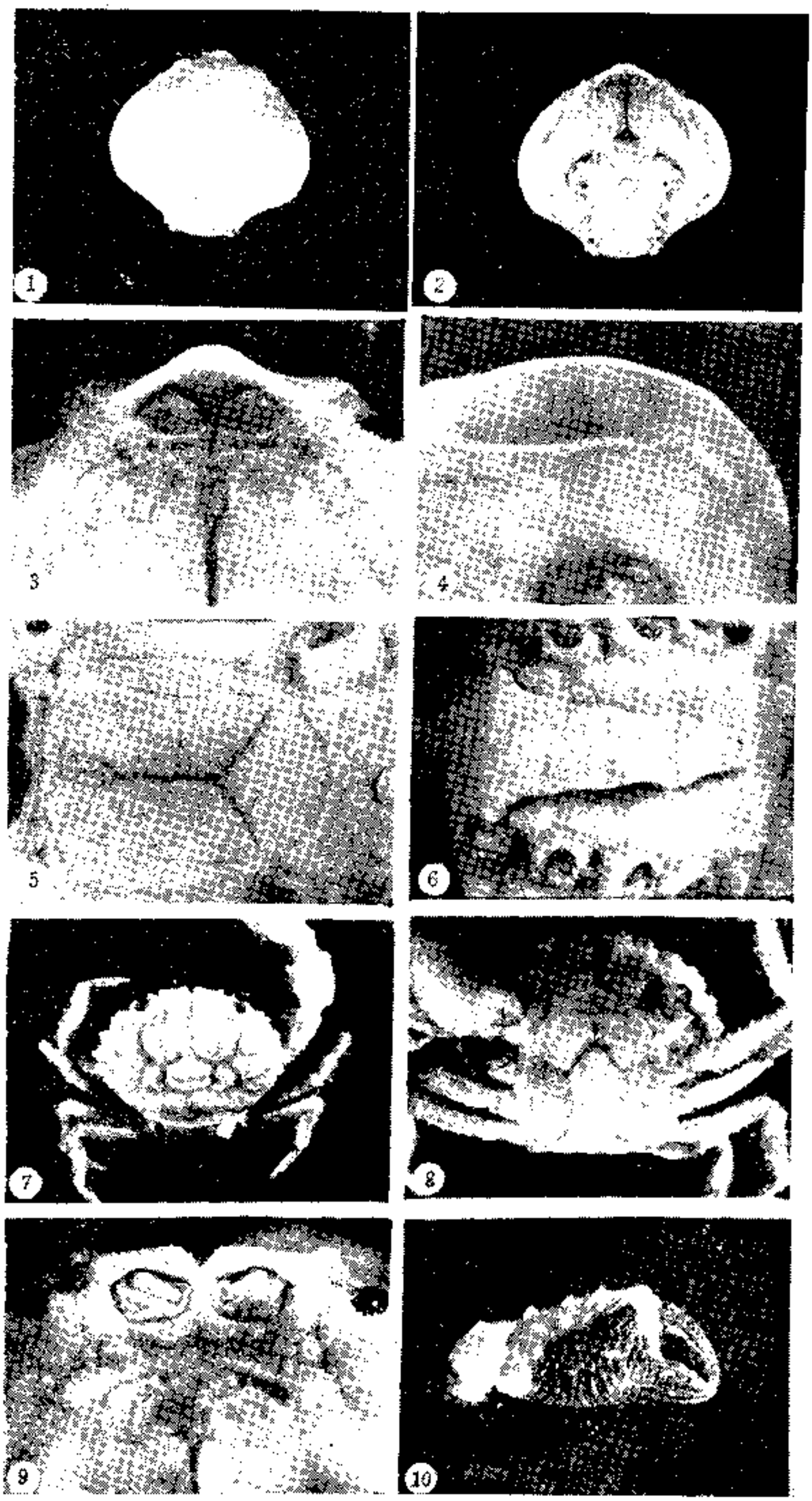

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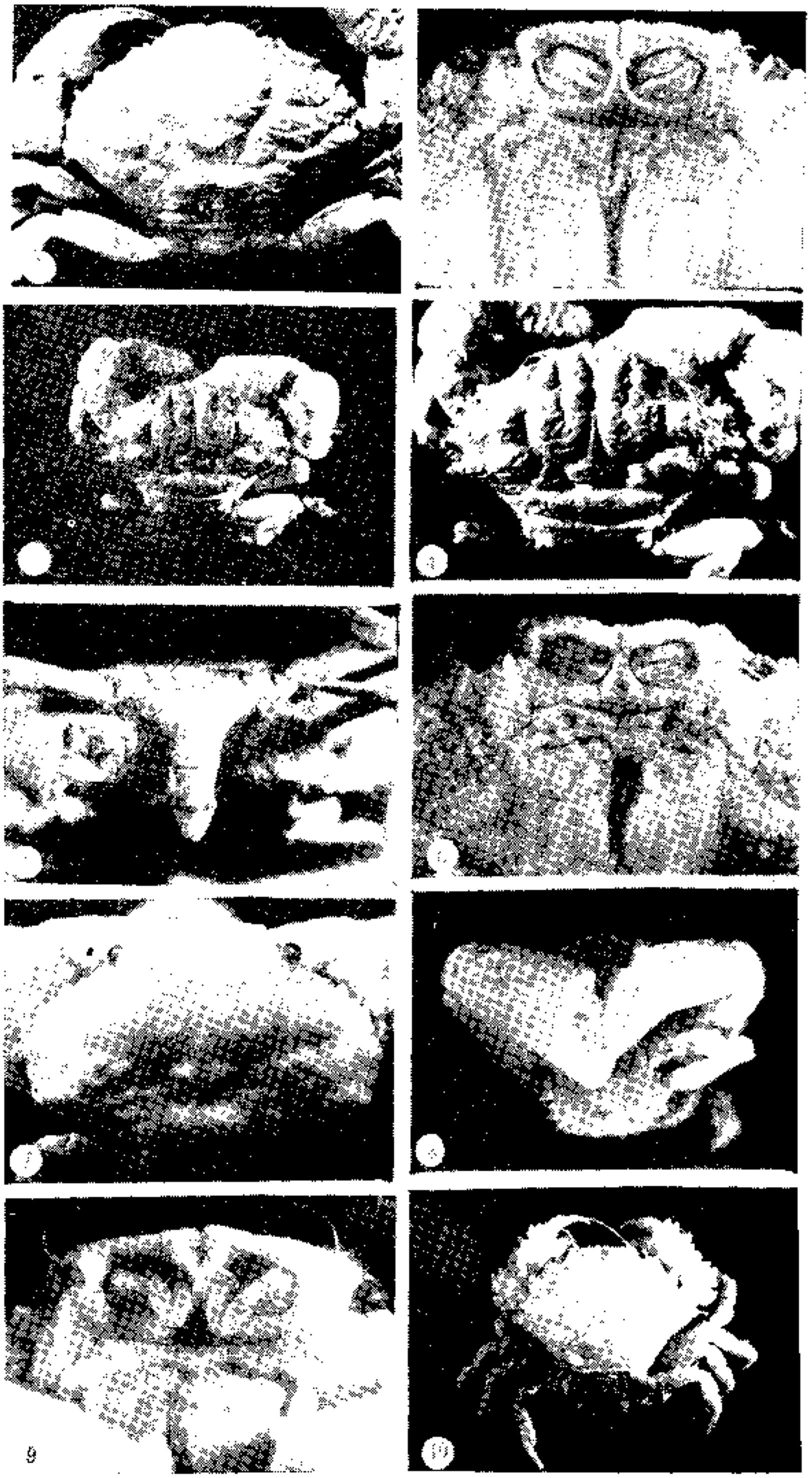

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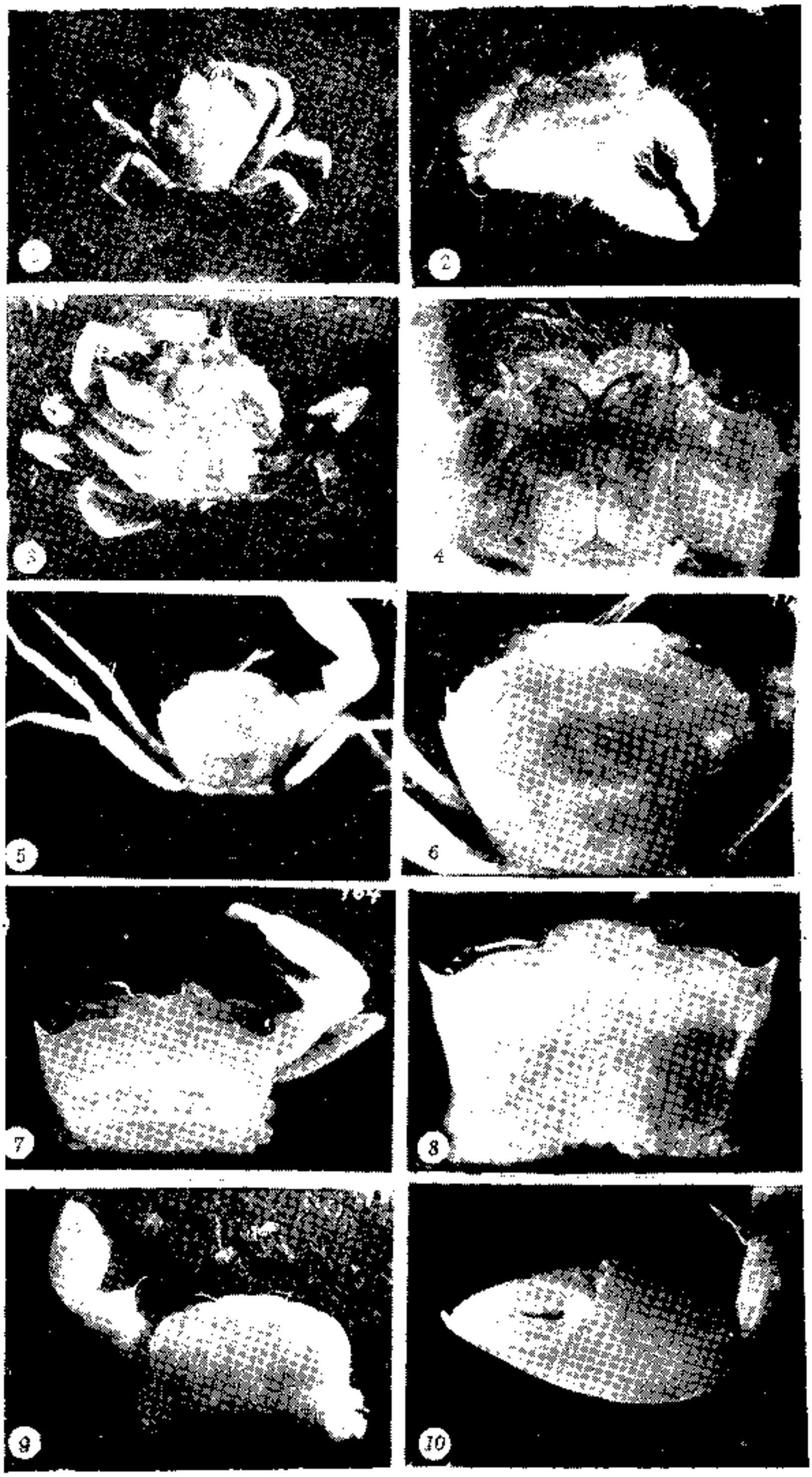

PLATE 8.

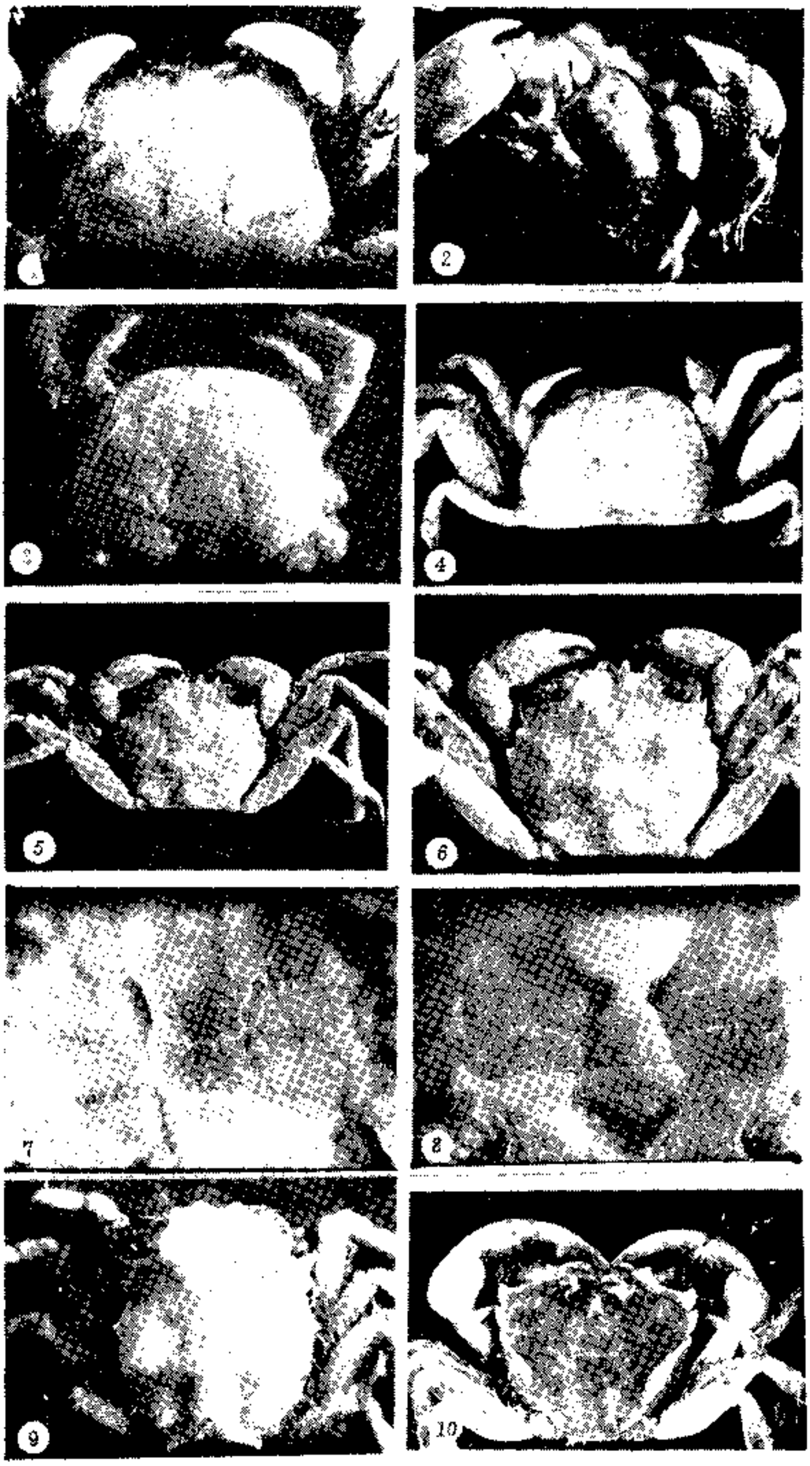

PLATE 9.

PUBLICATIONS AVAILABLE

CHECKLIST OF THE ANTS (HYMENOPTERA: FORMICIDAE) OF ASIA. By J. W. Chapman and S. R. Capco. Institute of Science and Technology Monograph 1 (1951) new series. Paper, 372 pages. Price. $2.00, United States currency.

NOTES ON PHILIPPINE MOSQUITOES, XVI. GENUS TRIPTEROIDES. By F. E. Baisas and Adela Ubaldo-Pagayon. Institute of Science and Technology Monograph 2 (1952) new series. Paper, 198 pages with 23 plates and four text figures. Price $2.50, United States currency.

A REVISION OF THE INDO-MALAYAN FRESH-WATER FISH GENUS RASBORA. By Martin R. Brittan. Institute of Science and Technology Monograph 3 (1953) new series. Paper, 224 pages with three plates and 52 text figures. Price, $2.50, United States currency.

SECURING AQUATIC PRODUCTS IN SIATON MUNICIPALITY, NEGROS ORIENTAL PROVINCE, PHILIPPINES. By Donn V. Hart. Institute of Science and Technology Monograph 4 (1956) new series. Paper, 84 pages with 22 text figures and eight plates. Price, $1.25, United States currency.

AN ECOLOGICAL STUDY OF THE KOUPREY, NOVIBUS SAUVELI (URBAIN). By Charles H. Wharton. Institute of Science and Technology Monograph 5 (1957) new series. Paper, 111 pages with 11 plates and 16 text figures. Price, $1.25, United States currency.

FERN FLORA OF THE PHILIPPINES. By Edwin B. Copeland. Institute of Science and Techonology Monograph 6, Vols. 1-3 (1958-1960) new series. Vol. 1, 191 p., Paper, Price, $1.25; Vol. 2, 193-376 p., Paper, Price, $1.75; Vol. 3, 377-577 p., Paper, Price $1.75, United States currency.

THE PHILIPPINE PIMPLINI, POEMENIINI, RHYSSINI, AND XORIDINI. By Clare R. Baltazar. National Institute of Science and Technology Monograph 7 (1961) new series. Paper, 120 pages with four plates. Price, $1.50, United States currency.

PACIFIC PLANT AREAS. Edited by C.G.G.J. Van Steenis. National Institute of Science and Technology Monograph 8, Vol. 1 (1963) new series. Paper, 246 pages with 26 maps. Price, $3.00, United States currency.

INDEX TO THE PHILIPPINE JOURNAL OF SCIENCE, VOL. 59 (1936) TO VOL. 79 (1950). By Angel Y. Lira. National Institute of Science and Technology Monograph 9 (1963) new series. Paper, 325 pages. Price, $3.00, United States currency.

THE ARCHAELOGY OF CENTRAL PHILIPPINES. By Wilhelm G. Solheim, II. National Institute of Science and Technology Monograph 10 (1964) new series. Paper, 235 pages with 29 text figures and 50 plates. Price, $3.00, United States currency.

SHIFTING CULTIVATION AND PLOW AGRICULTURE IN TWO PAGAN GADDANG SETTLEMENTS. By Ben J. Wallace. National Institute of Science and Technology Monograph 11 (1970) new series. Paper, 117 pages with 1[illegible] text figures and five plates. Price, $1.50, United States currency.

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